Rock Products
With which is Incorporated CEMENT and ENGINEERING NEWS Founded 1896

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Basalt Rock Company Plant

Evolution of a California Hard Rock Operation Based on Years of Experience

By Ernest Moyer
Alturas, Calif.

OWNING 160 acres of mountainside, including ledges of high quality basalt rock, locating a shipping point combining rail, water and truck loading facilities, a canyon to cross, a hill to go over or through, and moving the quarry output nearly two miles to the shipping point, were some of the problems facing the Basalt Rock Co. when planning the erection of its rock crushing plant near Napa, Calif., several years ago. The quarry was higher than the shipping point selected so that gravity aided the flow of the material. In the description which follows it will be shown how these problems were solved and how certain of the difficult conditions were utilized to advantage.

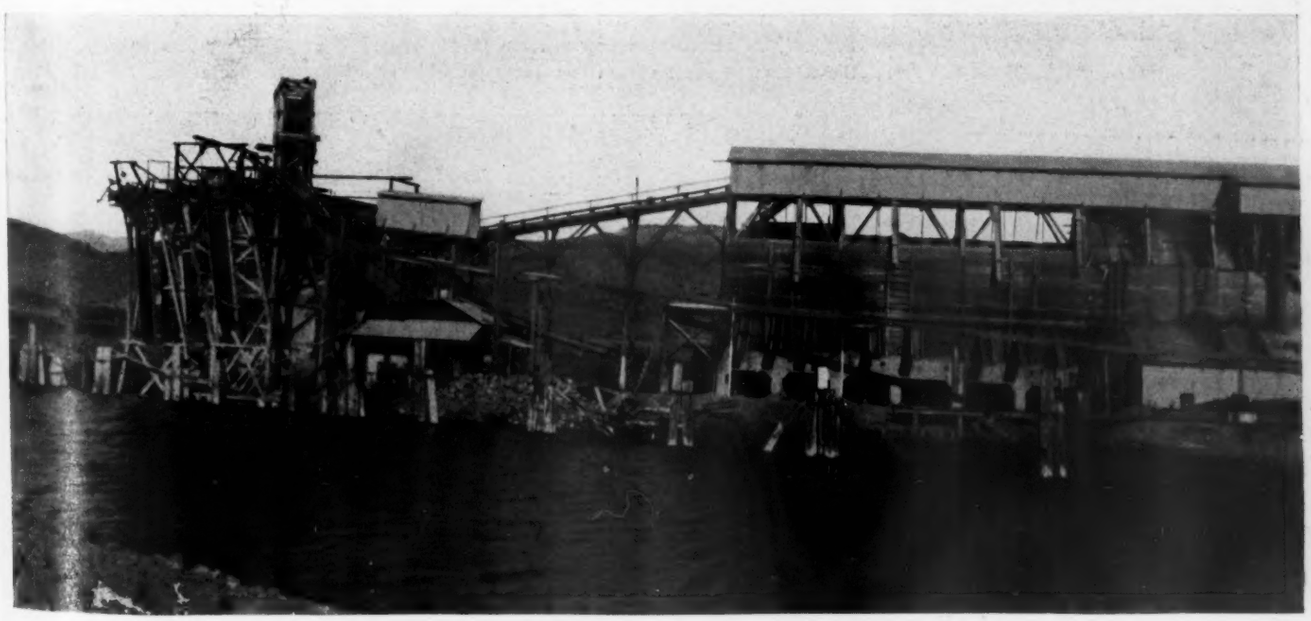
Quarrying

The deposit is a dense, hard, dark-blue basalt which is seamed rather than stratified and occurs in cubes or boulders which break with a minimum of slabbing. The quarry floor is some 50 ft. above the feed level of the primary crusher and it is kept smooth and clean for truck travel. The quarry face is about 150 ft. high at the highest point and is more than 1000 ft. long.

The primary blasting is done by the tunnel method, using a main tunnel 40 to 50 ft. long and cross tunnels 25 to 40 ft. long in each direction. Trojan explosives are used with two electric caps imbedded in 50 lb. of 60% dynamite in each charge. For secondary blasting the boulders are block-holed, using Ingersoll-Rand Jackhamer drills and 60% Trojan dynamite with caps and fuse.

A 1¼-yd. Marion full revolving crawler-type electric shovel is used for quarry loading. Of interest is the protective covering of the cable supplying the shovel with 440-volt alternating current. The insulation on this cable is doubly protected, first, by a wrapping of asphalted rope and then by a tight wrapping of heavy asphalted canvas.

The haulage of the rock from the shovel to the primary crusher is taken care of by two Mack trucks equipped with 5-yd. dump bodies which were designed by the company and built locally. These bodies have heavy



End loading point of plant; aerial tramway at left and bunker at right

Electric shovel loading to quarry truck

View of quarry face

framing of I-beams, channels and angles, with double plates and wood fillers on the bottom, sides and front. The sides flare out and slope up from the rear to a height at the front end which is slightly higher than the cab. They are loaded by the shovel from the rear and the high front end of the body protects the cab and driver.

The trucking distance is from 1000 to 3000 ft. round trip. The trucks dump to a large concrete bunker above the crusher and a heavy hinged baffle hung in the bunker opening helps to regulate the feed to the crusher.

Primary Crushing

The primary crusher is a 30-in. Traylor "Bulldog" gyratory crusher which is driven by a 300-hp. General Electric motor. This drive consists of a Bodison short center (8-ft.) drive using a 22-in. endless leather belt. The crusher opening is large enough to take any size stone passing the shovel dipper, thus saving loss of time at this point. The crushed material feeds to an inclined 30-in. by 160-ft. belt conveyor, the chute being provided with grizzly bars so that a layer of fine material is placed on the belt first and thus protects it from the abrasive action of the coarser material.

First Aerial Tramway

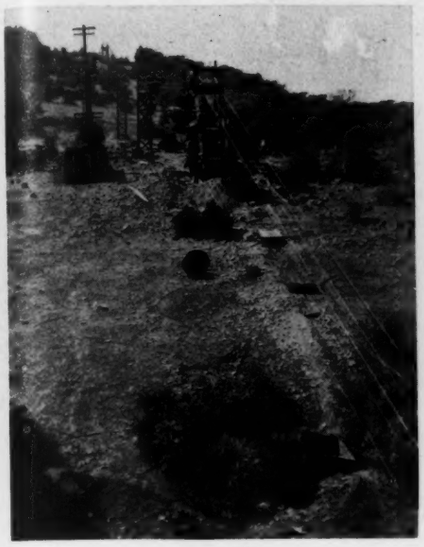
From this belt the material drops to a 100-cu. yd. capacity bunker that serves as the feeding point of an aerial tramway 3000 ft. long, which carries the material over the top of a hill and down the other side to the secondary crushing and screening plant. Loaded 4-wheel tram cars of about 1-yd. capacity ride the top run of the cable track, the empties returning below. Weights at the tension towers maintain a constant tension on both runs. The cars are spaced and clamped to a separate traction cable.

The tramway is driven at the upper end by a 25-hp. variable speed motor through a belt and reduction gearing. As the discharge end is considerably lower than the feed end and runs by gravity when the cars are all loaded, the head shaft is provided with a heavy duty band brake. Automatic dogs or clamps on the head sheave clamp the traction cable on the arriving side and release it on the top or leaving side.

Loading of the cars is semi-automatic. Under the bunker is a large undercut quadrant gate which is operated by a long lever and discharges direct into a steel hopper of the same capacity as one tram car. The side of the hopper facing the car travel is hinged at the top and latched at the bottom. The arriving car strikes the latch, the hopper side swings out, the car is loaded, and the side swings back and latches. The operator then refills the hopper and the next car repeats the operation. At the present

Swinging baffle at hopper feeding primary crusher

Receiving opening of primary gyratory crusher



Tramway from primary crusher to recrushing plant

Primary crusher at left and bin for loading tramway at right

car spacing and speed the capacity is about 125 yd. per hour.

Starting and stopping controls are located at the operator's station, and also one of the plant phones, so that he can receive instant instructions from the discharge end. A powerful Klaxon horn, by a system of numbers, is used by the tram operator to call any of the quarry force to the phone. A successful safety device, perfected by the quarry superintendent, is a portable phone set using the tram cables for transmission. This is always used whenever there is a man working anywhere on the tram line. The tram operator keeps all controls closed until he receives definite instructions over this phone to start.

This tramway installation and a similar one following it were furnished by the Interstate Equipment Co. of New York.

Secondary Crushing and Storage

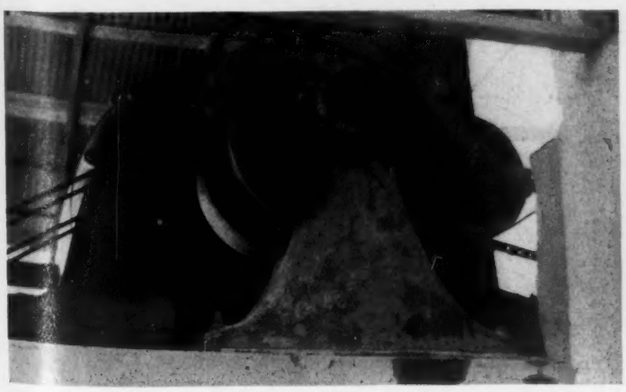
The secondary crushing, screening and open storage section at discharge end of this tramway is located where the natural ground elevations are particularly favorable for this installation. Surge feed bunkers for the secondary crushers, and the segregation bunker under the screens, are on top of, and at the edge of, a small bluff. Opening out about 50 ft. below from the foot of the bluff the country is approximately level, although still higher than the shipping location. On this is the open storage.

The material from the tramway (minus 6-in. size) is chuted direct to a 4-ft. by 10-ft. double deck Niagara vibrating scalping screen, the impact of this discharge being retarded somewhat by a heavy, counterweighted baffle hinged over the chute.

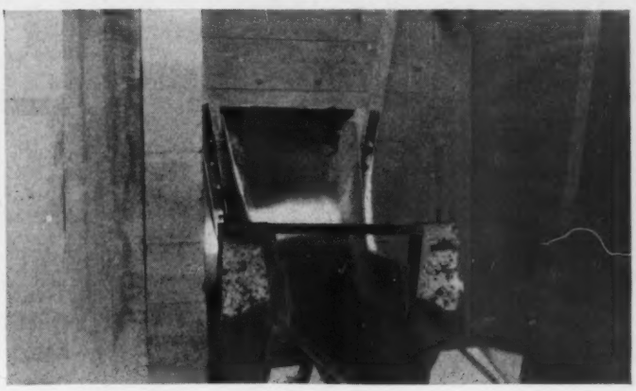
Tramway tension tower

The upper deck of the scalping screen consists of 3 ft. of ¾-in. mesh, 4 ft. of 2½-in. mesh and 3 ft. of 3½-in. mesh extra heavy wire cloth. The lower deck consists of 3 ft. of ¾-in. mesh and the balance of any desired size mesh. The top deck is to withstand the impact of the discharge and take part of the load off of the lower deck. All minus ¾-in. material, which includes all dirt and rock coatings, is chuted direct to a conveyor and is stacked as waste, although it is much in demand and is sold as a road binder and railroad ballast. After the minus ¾-in. material has been scalped out all remaining material is clean and hard.

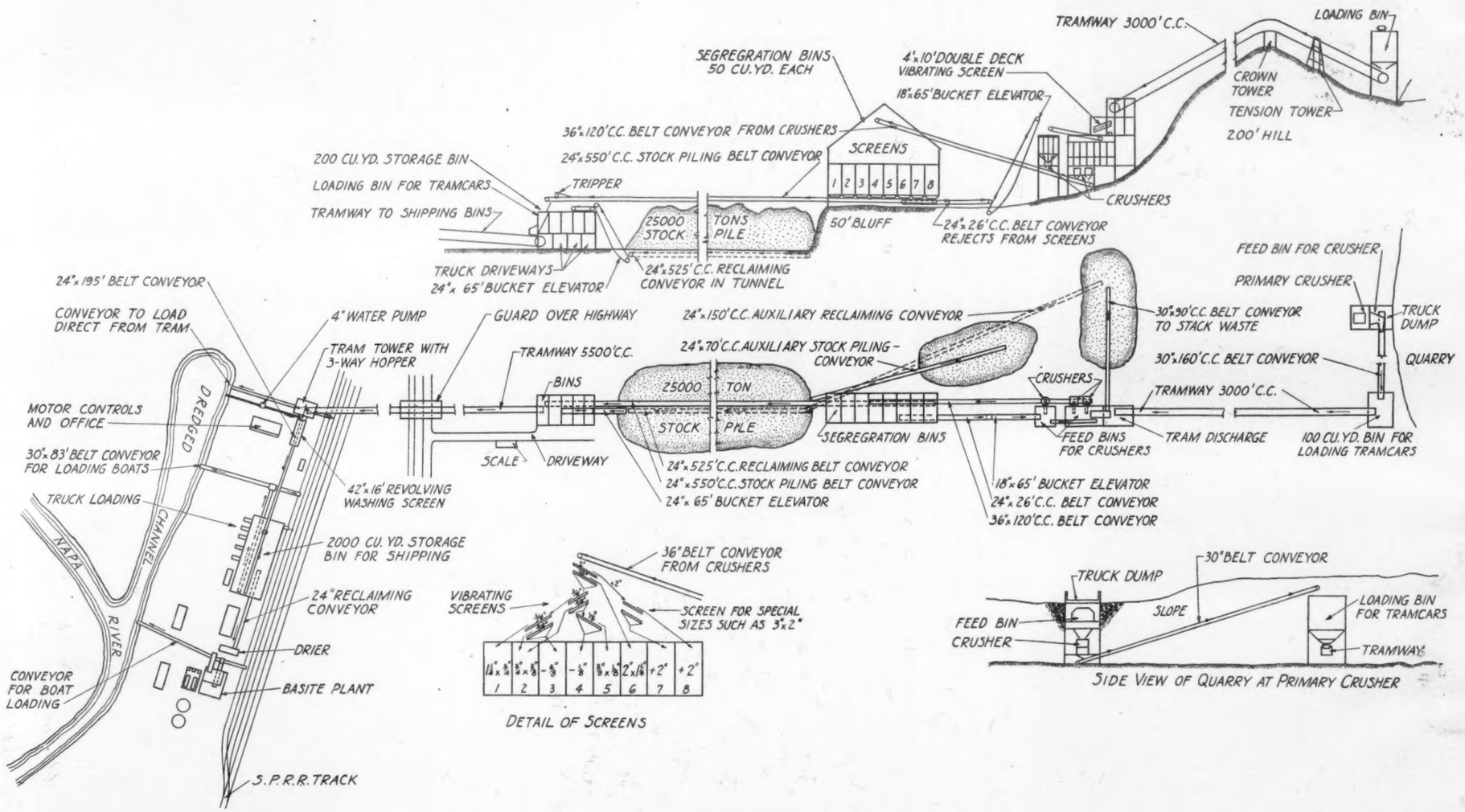
From the scalping screen part of the material falls to feed bunkers over two Telsmith reduction crushers and part is carried on a short belt conveyor to a bunker above a 3-ft. Symons cone crusher. The three reduction crushers are set below and at one side of the feed bunkers. The Telsmith crushers are fed through rack and pinion operated slide gates, watched by an attendant, as the rock is inclined to arch. The cone is fed by the customary chute and rock box. Both Telsmith crushers are belt



Short center belt drive to primary crusher



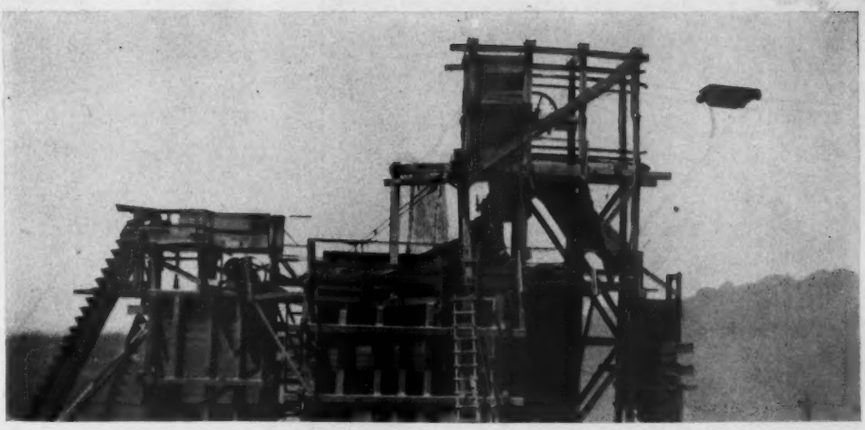
Discharge chute from primary crusher to belt conveyor


TRAMWAY 3000' C.C.
LOADING BIN
SEGREGRATION BINS 50 CU. YD. EACH
4' x 10' DOUBLE DECK VIBRATING SCREEN
18" x 65' BUCKET ELEVATOR
CROWN TOWER
TENSION TOWER
200' HILL
36" x 120' C.C. BELT CONVEYOR FROM CRUSHERS
24" x 550' C.C. STOCK PILING BELT CONVEYOR
SCREENS
1 2 3 4 5 6 7 8
200 CU. YD. STORAGE BIN
LOADING BIN FOR TRAMCARS
TRIPPER
TRAMWAY TO SHIPPING BINS
CRUSHERS
25000 TONS STOCK PILE
50' BLUFF
24" x 26' C.C. BELT CONVEYOR REJECTS FROM SCREENS
TRUCK DRIVEWAYS
24" x 65' BUCKET ELEVATOR
24" x 525' C.C. RECLAIMING CONVEYOR IN TUNNEL
FEED BIN FOR CRUSHER
PRIMARY CRUSHER
TRUCK DUMP
24" x 195' BELT CONVEYOR
CONVEYOR TO LOAD DIRECT FROM TRAM
4" WATER PUMP
GUARD OVER HIGHWAY
24" x 150' C.C. AUXILIARY RECLAIMING CONVEYOR
30" x 90' C.C. BELT CONVEYOR TO STACK WASTE
TRAM TOWER WITH 3-WAY HOPPER
TRAMWAY 5500' C.C.
24" x 70' C.C. AUXILIARY STOCK PILING CONVEYOR
30" x 160' C.C. BELT CONVEYOR
QUARRY
BINS
25000 TON STOCK PILE
CRUSHERS
TRAMWAY 3000' C.C.
MOTOR CONTROLS AND OFFICE
DREDGED CHANNEL
30" x 83' BELT CONVEYOR FOR LOADING BOATS
SCALE
DRIVEWAY
SEGREGRATION BINS
FEED BINS FOR CRUSHERS
TRAM DISCHARGE
100 CU. YD. BIN FOR LOADING TRAMCARS
42" x 16' REVOLVING WASHING SCREEN
24" x 525' C.C. RECLAIMING BELT CONVEYOR
24" x 550' C.C. STOCK PILING BELT CONVEYOR
24" x 65' BUCKET ELEVATOR
18" x 65' BUCKET ELEVATOR
24" x 26' C.C. BELT CONVEYOR
36" x 120' C.C. BELT CONVEYOR
TRUCK LOADING
NAPA RIVER
2000 CU. YD. STORAGE BIN FOR SHIPPING
24" RECLAIMING CONVEYOR
36" BELT CONVEYOR FROM CRUSHERS
VIBRATING SCREENS
SCREEN FOR SPECIAL SIZES SUCH AS 3" x 2"
DRIER
CONVEYOR FOR BOAT LOADING
BASITE PLANT
1¼" x ⅜" 1" x ⅜" -⅜" -⅜" ⅜" x ⅜" 2" x 1¼" +2" +2"
1 2 3 4 5 6 7 8
DETAIL OF SCREENS
30" BELT CONVEYOR
TRUCK DUMP
SLOPE
LOADING BIN FOR TRAMCARS
FEED BIN
CRUSHER
TRAMWAY
SIDE VIEW OF QUARRY AT PRIMARY CRUSHER
S.P.R.R. TRACK

Layout of Basalt Rock Co. plant at Napa, Calif.

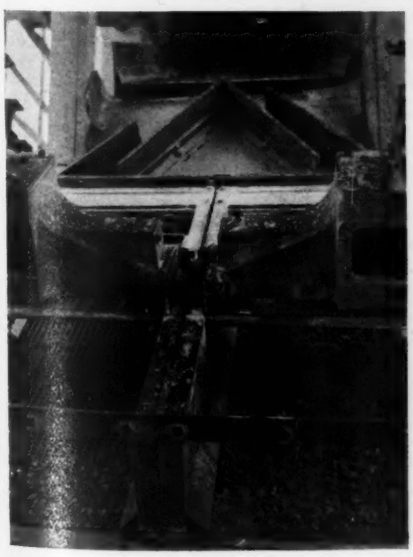
driven, one by a 50-hp. General Electric and one by a 50-hp. Fairbanks-Morse ball-bearing motor. The cone crusher is Texrope driven by a Fairbanks-Morse 60-hp. ball-bearing motor.

The discharge from the three reduction crushers is carried up to the sizing screens above the segregation bunkers by an inclined 36-in. by 120-ft. belt conveyor which discharges to a 4-ft. by 8-ft. double-deck Niagara vibrating screen equipped with 2-in. mesh cloth on the top deck and 1¼-in. mesh on the bottom deck. The course of the stone over the various screens is shown in the accompanying illustrations. The 8-compartment bunker below the screens is of concrete, steel and timber construction as shown in the illustrations.



End of tramway from primary crusher discharging to scalping screen at recrushing plant

Scalping vibrating screen



Method of dividing load to two vibrating screens

Underneath compartments 6, 7 and 8, at one side of the center, are gates feeding a 24-in. by 26-ft. conveyor, which in turn feeds an 18-in. by 65-ft. bucket-belt elevator discharging to the cone feed bunker, thus forming a flexible closed circuit with plenty of storage capacity. On the opposite side of the bunkers, under all the compartments, and fed by gates, is the main stockpiling conveyor to open storage, 24-in. by 550-ft. centers, level and about 50 ft. above the ground level of the storage area. A Bodinson tripper discharges material from the segregation bunker to storage piles. A short distance out from the bunker, facing back toward the waste, is an auxiliary storage conveyor, 24-in. by 70-ft. centers, fed from the main conveyor by the tripper. This is used to stack minus 1-in. road rock. The total open storage capacity is about 25,000 tons.

Any one of the bunker compartments, each holding about 50 yd., can be quickly emptied. Doing this, and changing screen panels, works out as a very flexible arrangement whenever a change in size of product is wanted.

Reclaiming and Shipping

Below the open storage, in a concrete tunnel, is a 24-in. by 525-ft. reclaiming conveyor. Feeding the tail end of this is an auxiliary conveyor, 24-in. by 150-ft. centers, reclaiming from below the waste and minus 1-in. road rock piles. The main reclaiming conveyor feeds a 24-in. by 65-ft. bucket-belt elevator which discharges to a 24-in. shuttle conveyor, traveling lengthwise over a 200-yd. capacity, five-compartment bunker. At this point unwashed material is loaded to trucks below the bunker.

The end compartment of this bunker fac-

Feed box over vibrating screen

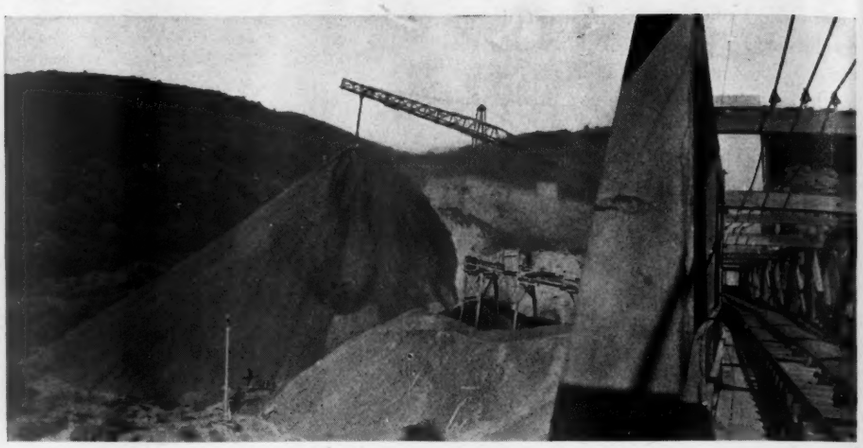
Segregation bunkers with sizing screens above

ing the shipping section beyond is used to load tram cars, traveling over a tramway similar to the one already described except that it is 5500 ft. long, and that the country traversed is nearly level. The tram car loading compartment can be fed either by reclaiming conveyor, elevator and shuttle conveyor from open storage, or direct from the segregation bunker with the tripper of the stockpiling conveyor set at the end.

This tramway, crossing a state highway and electric and steam railroad lines, discharges at the washing and shipping section of the plant. A three-way flop gate in the tram discharge tower chutes material direct to cars, on to a conveyor to the dock, or to a washing screen. A two-way flop gate in this chute routes the material through the washing screen, or by-passes the screen, feeding direct to a 24-in. by 195-ft. inclined belt conveyor which delivers to a storage and loading bunker of 2000 cu. yd. capacity.

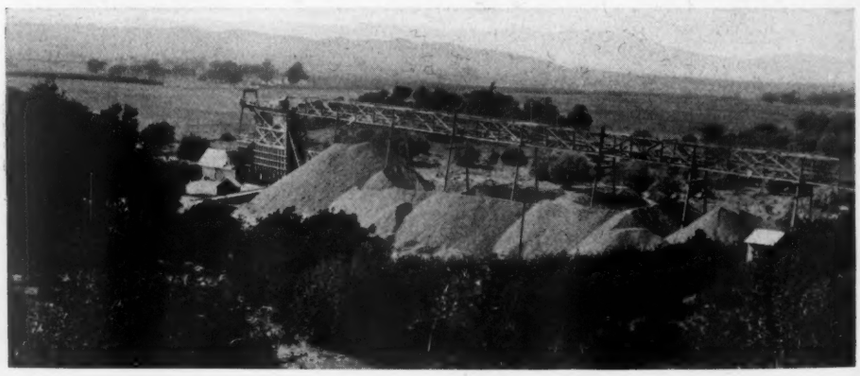
The washing screen is a Bodinson 3½-ft. by 16-ft. rotary screen with a 6-ft. blank section at the feed end and 10 ft. of ¾-in. perforations wrapped with 16 mesh wire cloth. The wash water, carrying the minus 16 mesh fines, or small amount of dust adhering to the rock, is flumed to a sump. The rinsed material feeds on to the 195-ft. conveyor and is discharged either to the bunker compartments, or, at one station, direct.

The 2000-yd. capacity bunker is of similar construction to the one already described, being of reinforced concrete up to a point a few feet above the floor line, with walls and partitions of 2x6 plank, cribbed. Below this bunker is a 30-in. by 150-ft. inclined reclaiming conveyor discharging to either of two 30-in. conveyors located at right angles to it, one of these loading to barges on one side and the other to railroad cars on the other side. Rinsing jets give the material a final washing at both loading points. Trucks may also be loaded from one side of this bunker.

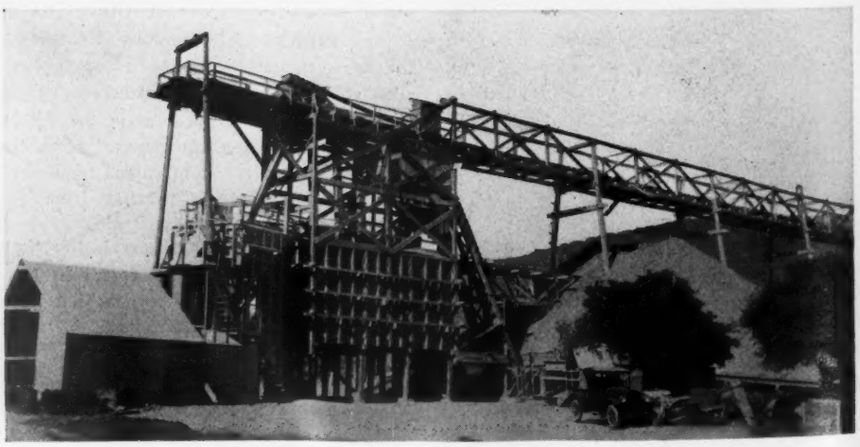


Storing minus 1-in. road material

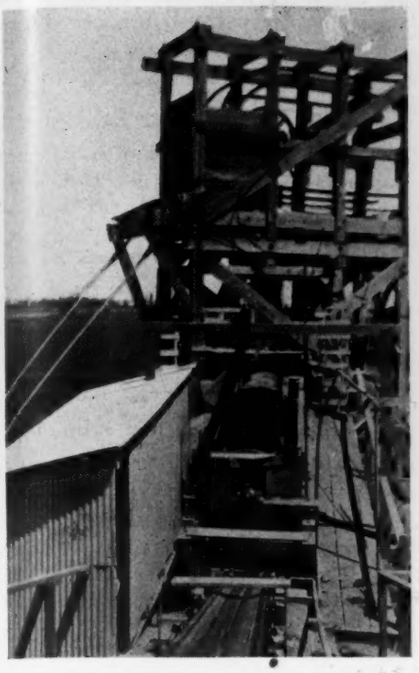
View from end of tramway looking toward plant



Open storage beyond sizing plant



Tramway and truck loading plant at end of open storage



Washing screen at end of 5500-ft. tramway

Loading bunker with truck loading spouts and reclaiming conveyor below

Basite Plant

Beyond the bunker is the "Basite" plant where bituminous or asphaltic road materials are manufactured. The aggregate materials are reclaimed from the end compartments of the bunker on a 24-in. inclined belt conveyor which discharges to a 3-ft. by 16-ft. direct-fired rotary dryer. The dried material is then carried up by a chain bucket elevator to a 55-yd. two-compartment Blaw-Knox steel bunker from which volume batchers measure the materials into a Geiger mixer, or pugmill. Heated oil of heavy asphaltic content is measured into the mixer by weight. Various sizes of rock make up the "Basite," usually ½-in. minus. Some specifications call for a large ratio of rock dust, and to supply this a Hendy ball mill is installed alongside the bunker.

The basite is mixed as ordered, trucks backing down a concrete ramp and being loaded directly below the mill. Car and boat shipments are loaded by conveyors. The oil used in the process is partially heated with steam generated in a 150-hp. locomotive type boiler, and is further raised to the required temperature in a retort built by the company. The boiler, retort and drier are oil fired. Two insulated, welded steel storage tanks of approximately 9000 gal. capacity each, fitted with steam coils, hold the temperature of the contents high enough, so that by pumping through the retort, oil hot enough for the mix is almost instantly available.

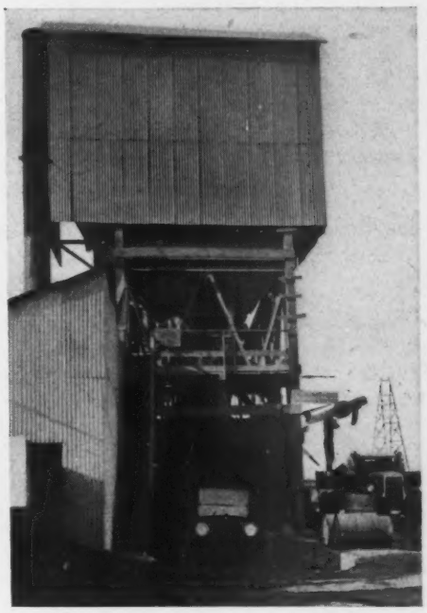
The plant is favorably located for rail, water and truck shipments. San Francisco and other cities on the Bay can be reached by water The Southern Pacific railroad handles shipments to any point. A network of excellent highways permits all possible truck shipments.

The shipping section is located between the railroad sidings and a channel dredged in from the Napa river.

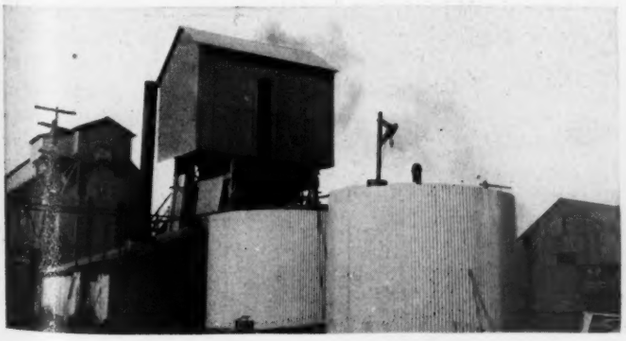
In addition to the usual products, the company has by experiment developed markets for other sizes and for special mixes. As an example of this, the quarry contains some thin layers of clay which goes to the waste pile from the first scalping screen. Mixed with this is the minus ¾-in. material from the primary crusher. This combination forms a material that packs readily, and when laid as a first course on any unstable soil is a satisfactory base on which to bond concrete, asphalt or oil mix pavements. Because of these same characteristics, considerable is also used by the railroads.

General

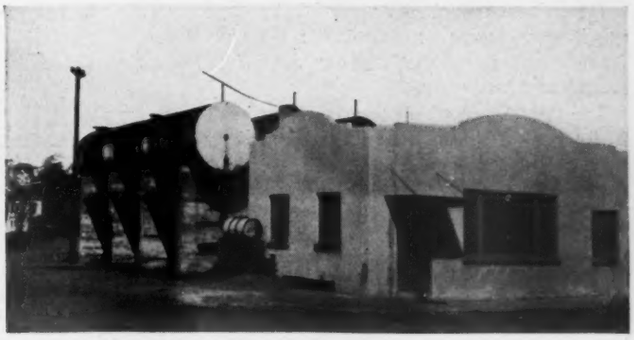
The conveying and elevating equipment is practically all of Bodinson Co. manufacture.



Basite plant with batching bins above



Basite plant and oil storage tanks



Main office and fuel oil storage tanks

Another view of loading point, bunker at right

The motors are mostly General Electric, with some Fairbanks-Morse, ball-bearing motors. Some drives have been changed from flat to Texrope. All other belting was furnished by the New York Belting and Packing Co.

All gates feeding the conveyors are simple hinged chutes which are raised or lowered to regulate the feed. A two-drum hoist driven by a 30-hp. motor is used as a car-puller for moving cars in either direction.

The main offices of the company are at Napa, Calif., and a branch office is maintained at Sacramento.

A. G. Streblow is president and general manager and H. Morris is secretary.

Moderate Success in Establishing a Standard for Feldspar

THIS report covering production of feldspar during the six months ending September 30, 1931, is based on 12 replies to a questionnaire circulated to feldspar producers.

Production of feldspar conforming to the requirements of Commercial Standard CS23-30 was reported as averaging 51% of individual production. (Average of 12 replies not weighted according to individual production.)

Complete adherence to the provisions of the Commercial Standard was reported by five producers, while five producers reported no adherence.

Deviations from the Commercial Standard requirements were attributed to: demands from purchasers, specification not close enough and lower costs.

The following methods to promote and sell feldspar meeting the Commercial Standard were used by manufacturers as indicated:

(*a*) Instructions to salesmen..... 8
(*b*) Pamphlets and sales literature..... 4
(*c*) Magazine or newspaper advertising.... 4
(*d*) Certifying conformity by use of certificate label, or trade mark..... 7

Actual direct benefits from the establishment of the Commercial Standard were reported by seven producers.

Six producers considered the establishment of the Commercial Standard a benefit to the industry as a whole.

The following comments and criticisms are extracted from correspondence with producers:

"Purchasers pay but scant attention to this specification."

"Too complicated and involved for practical purchasers."

"Its general use would force the small producer to install very expensive equipment, and add greatly to operating costs for something the trade does not desire or demand."

"The standard has been very satisfactory."

"Our materials are ground to meet the individual requirements of our customers and we do not find that they are adhering very generally to Commercial Standard CS-23-30."

"We do not believe that the present Commercial Standard is understood by the general trade. They have varying ideas of their requirements and expect the grinders to supply them with what they want, their formulas regulating their needs."

"Adherence not 100% among producers."

Suggested changes are offered as follows:

"Classification should allow 1% tolerance on silica only."

"Adopt a system that will consider the physical behavior of feldspar, rather than its minute chemical composition."

"A much finer grade of feldspar should be adopted; such a fineness can be produced regularly."

"Establish a limit as to fineness of the feldspar."

"20-G (granular) new grinding not classified."

List of those who replied to questionnaire:

American Mineral Products Co., Inc., New York, N. Y.
Consolidated Feldspar Corp., Trenton, N. J.
Eureka Flint and Spar Co., Inc., Trenton, N. J.
Feldspar Milling Co., Inc., Burnsville, N. C.
Franzheim Co., Charles M., Wheeling, W. Va.
North State Feldspar Corp., Micaville, N. C.
Oxford Mining and Milling Co., West Paris, Me.
Rock Products Co., Silica, Ohio.
Seaboard Feldspar Co., Baltimore, Md.
Standard Flint and Spar Corp., Trenton, N. J.
Tennessee Mineral Products Corp., Spruce Pine, N. C.
United States Feldspar Corp., Northville, N. Y.

Feldspar Production in Canada

FELDSPAR production in Canada during December amounted to 591 tons, a decline of 51% from the November total and 81.9% from the December, 1930, shipments, according to a statement issued by the Dominion Bureau of Statistics at Ottawa. Production during the calendar year 1931 totalled 16,120 tons, a falling-off of 39.8% from the shipments in 1930.

Canadian Gypsum Production

CANADIAN PRODUCERS reported a production of 53,207 tons of gypsum in December as compared with 50,135 tons in November and 82,415 tons in December, 1930. Production during the calendar year 1931 totalled 844,032 tons; made up of 81.5% from Nova Scotia; 6.9% from New Brunswick; 6.4% from Ontario; 2.7% from Manitoba; and 2.5% from British Columbia. In 1930, the total production was 1,070,968 tons.

In October, 1931, a new gypsum producer in Ontario, the Canadian Gypsum Co., commenced operations at Hagersville.

Canadian Asbestos Production

SHIPMENTS of asbestos by Canadian producers in December, 1931, amounted to 10,523 tons as compared with 14,068 tons in November and 18,754 tons in December, 1930. The Dominion Bureau of Statistics at Ottawa reports asbestos production during the calendar year 1931 at 163,388 tons; in 1930, shipments totalled 242,114 tons.

Physical Testing of Explosives

THE Bureau of Mines, U. S. Department of Commerce, has issued Bulletin 346, giving in detail the methods used in making physical tests of explosives at the experiment station, Bruceton, Penn.

This 144-page booklet, which includes all revisions to date, can be obtained from the Superintendent of Documents, Washington, D. C.

New Pavement Awards

CONCRETE PAVEMENT yardage as awarded in the United States during February and for the period ending February 27 as reported by the Portland Cement Association follow:

	Yardage awarded	
	During February, 1932	To date, February 27, 1932
Roads	3,083,876	5,335,924
Streets	170,857	404,991
Alleys	108	38,139
	3,254,841	5,779,054

New British Standard for Testing Sieves

By Edmund Shaw
Contributing Editor, Rock Products

A LONG STEP forward toward an international standard for testing sieves has been taken by the British Engineering Standards Association in adopting a new specification for testing sieves. These are abstracted in a recent issue of *The Quarry and Roadmaking*, a British publication. The article says that in making these specifications the committee had before them the standard sieves of the Institution of Mining and Metallurgy together with the standard sieve series of the U. S. Bureau of Standards. They threw overboard the I.M.M. sieves and adopted sieves that are practically the same as those of the U. S. Standard series for the finer sizes. Unfortunately they did not go the whole way but adopted specifications for medium sieves, from 1/32-in. to ½-in. of woven wire cloth, and of course with square openings. Then for the sizes from ½-in. to 2-in. they specified perforated metal plate, thus adopting two of the features which have proven so troublesome in this country, a series that is not connected directly with the fine sieve series and the use of round holes for the coarser sizes.

The adoption of the Institution of Mining and Metallurgy sieve series was a mistake from the beginning. The writer remembers that there were many protests at the time of its adoption from engineers in England and the United States. It may be asked what right engineers from the United States or any other foreign country had to protest against a British institution's action, but it seems to the writer that they had every right. The literature of chemical, mining and rock products engineering is now international, and so are the standards by which such materials as portland cement are bought and sold. Hence the standards adopted in any country should be such that they can be readily understood and applied, by all those who are interested in another country.

The I.M.M. series, as it is usually called, had no common ratio between sieve openings. The aperture of any sieve is—

$$\frac{1}{(2 \times \text{the mesh designation})}$$

Thus the aperture of a 20-mesh sieve is 1/(1x20) or 1/40-in. This makes the wire of the same width of the opening. The reason for adopting this relation of wire and opening was the hope that the wires on the fine sizes would be heavy enough to stand a solid crimping so that the meshes would not be distorted by use. But this hope was not met in practice, for the wires on the coarser sizes were too coarse to weave and the wires on the finer sizes were too fine to be durable.

Naturally, the resulting series of sieves resembled nothing that was in use either before or after its adoption. To show the difficulties that arose in trying to convert from it to any other system, it is given here together with the dimensions of the sieves of the same numbers in the U. S. Standard system:

Sieves of the old British I.M.M. Standard			Sieves of the same numbers of U. S. Standard		
	Opening in			Opening in	
Mesh	Inches	Mm.	Mesh	Inches	Mm.
5	.100	2.54	5	.157	4.00
8	.062	1.57	8	.094	2.38
10	.050	1.27	10	.079	2.00
12	.042	1.06	12	.066	1.68
16	.031	.79	16	.047	1.19
20	.025	.64	20	.033	.84
30	.017	.42	30	.023	.59
40	.012	.32	40	.0165	.42
50	.010	.25	50	.0117	.30
60	.0083	.21	60	.0098	.25
70	.0071	.18	70	.0083	.21
80	.0062	.16	80	.0070	.177
90	.0055	.14			
100	.0050	.13	100	.0059	.149
120	.0042	.107	120	.0049	.125
150	.0033	.084			
200	.0025	.063	200	.0029	.074

According to the article quoted, the Institution of Mining and Metallurgy must be credited with recommending a change in this series. Its representatives brought in a final report in which it recommended the sieves now adopted by the Engineering Standards Association, except that the Association added a 300-mesh sieve, the finest in the series.

The new series is based on the fourth root of 2 (1.189) as is the U. S. Standard series. But the designation, according to the paper quoted, is by common, not decimal, fractions of an inch. The main objection I find to such designations is the danger of confusion. For it is quite possible that the 1/200-in. sieve will be spoken of as a 200 sieve, and the No. 200 sieve of the U. S. Standard series is not 1/200-in. but 0.0029-in. opening, or 1/333. However, this will probably work itself out with use and one or the other methods will be commonly used.

For the sake of comparison, I have figured the common fractions given into decimals and compared these with the openings of sieves in the U. S. Standard system in decimals of an inch. It will be seen that these are so nearly identical that the difference is generally less than the plus or minus 3% permitted in testing sieves by A.S.T.M. specifications.

New British testing sieves		U.S. standard testing sieves	
Fraction	Decimal	Sieve No.	Decimal, in.
1/480	.00208	270	.0021
1/400	.0025	230	.0024
1/333	.003	200	.0029
1/288	.00348	170	.0035
1/240	.00416	140	.0041
1/200	.005	120	.0049
1/168	.00595	100	.0059
1/144	.00695	80	.0070
1/120	.00833	70	.0083
1/100	.01	60	.0098
1/84	.0119	50	.0117
1/72	.0139	45	.0138
1/60	.0167	40	.0165
1/50	.02	35	.02
1/42	.0238	30	.023
1/36	.0278	25	.028
1/30	.0333	20	.033
1/25	.04	18	.039
1/21	.0476	16	.047
1/18	.0555	14	.056
1/15	.0666	12	.066
1/12	.0833	10	.079 (*a*)
1/10	.1	8	.094 (*b*)
1/9	.1111	7	.111
1/8	.125	6	.132 (*c*)

The lack of correspondence in the sieves marked *a*, *b*, and *c* may be due to the fact that these are in the medium series mentioned, which are simply fractions of an inch in width of opening.

The article suggests that as all users of sieves may not wish to use the entire series the sieves may be grouped into four convenient groups which are:

I. 1/480, 1/240, 1/120, 1/60, 1/30, 1/15, 1/8.
II. 1/400, 1/200, 1/100, 1/50, 1/25, 1/12.
III. 1/333, 1/168, 1/84, 1/42, 1/21, 1/10.
IV. 1/288, 1/144, 1/72, 1/36, 1/18, 1/9.

The series marked III is practically the same as that used in the United States for sieving fine aggregates, except that it lacks the No. 4 sieve, which is: Nos. 200, 100, 50, 30, 16, 8 and 4.

The paper says that the specifications must be regarded as tentative only, so that a revision in the direction of greater accuracy and uniformity of aperture may be possible after one or two years experience has been gained.

The writer hopes in time that the U. S. Standard system will be adopted by all countries in which testing sieves are used. Not because it is American in origin, because nationality is the last thing that should be thought of in this connection, but because it could be so easily adopted by countries using the metric system, since it contains sieves of 4, 2, 1, ½, ¼ and ⅛ mm. Now that it promises to be commonly used in Great Britain and the United States, its adoption in the countries of Continental Europe should logically follow.

The Manufacture of Portland Cement

Part I—Introduction to a Brief General Survey of Its Economic and Technical Problems

By S. E. Hutton
Consulting Engineer, Seattle, Wash.

S. E. Hutton

THE MANUFACTURING of portland cement, like any other business, is entered into with the primary object of paying the wages and salaries of those persons engaged directly or indirectly in the operation, the costs of materials, services, supplies used, and interest on the money invested; or for the purpose of obtaining a promoter's fees and profits on the sale of stocks and bonds to finance the project. In the latter case, only the basis for a plausible story that will promote the sale of stocks and bonds is required. In the former, there is needed a knowledge of what cement is; what materials, processes, equipment, supplies, men and money are required to make it; and what to do with it to get out of it the money with which to pay dividends.

Many cement enterprises have been initiated, some merely to procure promoter's profits and some in the serious hope of earning dividends, without adequate knowledge of the subject and without proper, if any, investigation of the local, technical and economic considerations involved, and, in many instances, on unsound bases. In the early days this was not usually a serious hazard for the investor, largely on account of the continuous and rapid growth of the industry and the country; but as the operation was repeated in any district, and as competitors appeared with projects well worked out, technically and economically, the whole industry suffered. Overcapitalized projects, and those handicapped by relatively adverse economic conditions, antiquated plants and methods, and technically ignorant and economically ignorant and incompetent executives, invite competition. Other things being equal, the project with the soundest economic basis, and with the means of adapting itself to ever changing conditions, is most likely to be profitable and to survive.

The economic basis of any enterprise involves a market in which its product can be sold, and means for producing a competitive product at a cost that will leave a profit when sold at a competitive price. In effect, this usually means that a project must take such current and potential business in the district, and must have such facilities, and must follow such practices as to make its cost of producing and selling equal to or less than that of its competitors.

Factors Considered

An enterprise involves men, organization, money, materials, property, environment and time. Unfortunately, these factors cannot all be reduced to relative values in figures, and thus compared easily. Some can be and should be so compared. Others must be judged in the light of knowledge of past experiences and of such principles as have been and can be derived from them.

To be more specific, as to organization and men, for example, two similar enterprises may have about equal proportions of incompetent men in them, or one may have a great advantage over another in this respect; one may be well organized, with its business well understood, with its detail activities well classified and well distributed among competent men, and with a progressive and aggressive policy, while the other may have no coherent organization, a very imperfect understanding, classification and distribution of its work, a narrow view, and a defensive policy. The relative values of the details of organization, personnel, and policy in two enterprises cannot be expressed precisely in figures, but sufficient has been learned and recorded in these fields to improve the judgment of one who will study them.

While it is true that matters of organization and men, as well as matters of materials, property, locations, and chemical and physical phenomena, are essential elements in the success of any enterprise, it is usually necessary or advisable to deal with these two groups separately, and here we shall confine

Editor's Introduction

THIS article begins a very interesting series — a series that would be interesting any time, but is particularly so now. For if there ever was a time when it was appropriate and opportune for an industry to make an honest and unbiased appraisal of itself, that industry is the cement industry and that time is now.

This series of articles will give a general view of the economic and technical problems of the industry, suggest sources of information regarding them, or methods of attacking them. It will do what needs to be done periodically in every technical industry—generalize and summarize achievements in knowledge to date.

The author is a well known Pacific Coast engineer who, within the past 10 years, without previous experience in the cement industry, has gone through the entire range of experience from the conception of a cement manufacturing project (based on an advantage in freight costs), through preliminary investigations, the design and construction of the plant, production and use of its product.

Besides drawing on extensive and varied experiences in the field of engineering and other industrial fields, our author has made the best use of all published data available, and has contacted and associated with cement manufacturers all over the country. He approaches the portland cement industry as a whole and not through any one of its special branches. His purpose is a comprehensive understanding of the industry as a whole.

The author appreciates that he will meet with criticism, that there may be some who will look upon his efforts as elementary. But we know that specialists often pursue their specialty so assiduously as to overlook some very elementary things.

OUTLINE

Chapter I will cover cement manufacture in a broad way.

Chapter II will cover the composition and constituents of cement.

Chapter III will detail the properties of cement and the components of cement.

Chapter IV will be on raw materials of every character.

Chapter V will cover composition and control of raw mix.

—The Editor.

our attention to the latter. It must not be supposed, however, that an enterprise economicaly sound is proof against commercial failure in the hands of incompetent individuals or organizations, or if inadequately financed.

Factors Changeable and Unchangeable

Matters of personnel, organization, financing and management, as well as choice of equipment, are subject to human vagaries, and may be changed from time to time, for better or for worse, but the supplies of raw materials, the relative costs of transporting them to the mill, the kind of product that can be made from them, and the cost of delivering the finished product at the point of consumption, once fixed for an enterprise, are usually difficult and expensive and perhaps impossible to change. They, therefore, warrant the most painstaking investigation.

Perhaps it is the natural disposition of man to "muddle through" his affairs, but the trial and error method of handling things is at a serious disadvantage in competition with systematic study and planning, and must steadily give way to them. Volumes have been written on scientific management, efficiency, investigating industries, planning production, production control, and related topics, with highly beneficial effects on those enterprises whose executives have studied them, and have applied their precepts.

The factors that contribute to the success or failure of any enterprise are so numerous, so varied, and so intricate in their relations that no formula for success can be developed. There is no simple secret of success. Barring chance, which is a potent factor, success comes chiefly from thorough knowledge and understanding, and the intelligent, persistent use of such knowledge and understanding. Technicians and executives must keep on learning, if their enterprises are to survive competition.

Obligations of a Producer or Would-Be Producer

Whether one is engaged in making an investigation, organizing an enterprise, managing an operation, or doing anything else which is not purely repetitive, his tasks involve several obligations, if he would be thorough and efficient, viz.:

(*a*) The determining of the required and desirable objects or purposes of a project as a whole, and of each detail involved in carrying it out. Individuals are frequently, if not commonly, vague or confused as to the fundamental purposes of many of their actions. An organization, or, rather, a group of men working together and not perfectly organized, may suffer greatly from want of clearly defined and clearly understood purposes of the project as a whole, and of the acts and processes with which the individuals are concerned. This may explain why too many cooks spoil the broth.

(*b*) The finding of all the things that must be done, or which it is desirable to do, in order to accomplish a purpose.

(*c*) The investigating of all means by which the objects of an activity can be realized, whether or not they have been used previously for such purposes. This covers materials, methods, equipment, and even men.

(*d*) The making of a definite plan for carrying on each activity, to be adhered to, and to be revised as conditions warrant.

(*e*) The providing of necessary facilities—finance, men, organization, plans, equipment, etc., and, finally,

(*f*) Action—planned, prompt, aggressive, energetic, and persistent.

Through books, current publications, experience, and association with others in the industry, and by excursions into other fields, the cement man must recover lost bits of information, reject false notions, and gain new knowledge and new points of view, if he would be abreast of the times.

(*To be continued*)

Heavy Duty Bearings

ACCORDING to a recent issue of *The Iron Age,* a symposium on the general subject of bearings for heavy-duty service was held at the annual meeting of the American Society of Mechanical Engineers in New York. Five papers were presented and discussed as a group, these dealing principally with rolling mill bearings.

One paper gave results of power tests on the same mills alternately equipped with plain bearings and Timken tapered roller bearings, indicating power savings of 40 to 48% with the latter. Other advantages claimed are perfect alignment and continued accurate setting of the rolls as a result of the neglible wear in the roller bearings, so that accurary of the product is assured.

Some results of investigations of the properties of bearings made of copper and lead alloys were given in another paper. It was brought out in the discussion that these are best used for pressures below 900 lb. per sq. in. and that a good circulating system for cooling the oil is important.

Because of the rapid wear and excessive friction of many plain metal bearings in such service, researches and tests have been carried on with bearings made of hard woods and phenolic materials.

Hardwood bearings of lignum-vitae were stated to have shown as much as 23% less friction loss and up to 15 times longer life than plain metal bearings. These are lubricated with water sprays and used for pressures up to 5000 lb. per sq. in.

Bearings made of Celoron, a material made by subjecting layers of impregnated woven fabrics to heat and pressure, were also stated to have been used with satisfactory results. These are claimed to be resilient as well as hard and tough, with compressive strengths of 35,000 lb. per sq. in. and tensile strengths of half that amount, and showing friction coefficients of from 0.04 to 0.07 at speeds of 225 ft. per min. They have been made with an admixture of up to 5% graphite, carrying loads up to 5000 lb. per sq. in., and are lubricated with either oil or water. They are said to have shown less wear and friction and given many times the life of plain metal bearings.

Rubber bearings lubricated with water have a lower coefficient of running friction, although a higher static coefficient, and are used satisfactorily in deep well pumps, for handling slurry, and in sand washing operations, giving longer life than metal.

Cost of Drifting

MORRIS J. ELSING gives some interesting figures on the cost of driving 5 ft. by 7 ft. drifts in various types of ground in a recent issue of *Engineering and Mining Journal.*

As there are now roughly 200 rock products industries using underground mining methods, these comparative cost figures should be of interest. In one table he gives the footage per machine shift at seven different drifting operations. Two of these were in limestone or dolomite and the footage obtained per drill per shift was 80 to 100 ft. for the limestone and 53 to 99 ft. for the dolomite. The cost figures for drifting at the mines indicated are shown in the following condensed table. The totals do not include timbering.

The author also shows a table giving the estimated cost per foot of driving a 5- by 7-ft. drift in three classes of ground: soft, medium and hard ground. His estimated costs are $10.50, $13.35 and $16.20 per ft. respectively. He estimates timbering at $3.80 per ft. for 5x7-ft. drifts.

COST OF DRIFTS IN VARIOUS PLACES

Name and location of mine	Total cost, lineal foot, of drifting 5x7-ft. opening	Character of ground
United Verde, Jerome, Ariz.	$13.09	
Alaska Gastineau Mining Co., Juneau, Alaska	13.55	Slate
Alaska Gastineau Mining Co., Juneau, Alaska	15.12	Gabbro
Alaska Gastineau Mining Co., Juneau, Alaska	15.59	Schist
Tri-State District, Missouri	14.13	Limestone, sandstone, shale
Park Utah Mine, Park City, Utah	23.84*	Medium hard limestone, rock, limestone, quartzite
Davis Daley, Butte, Mont.	13.48	
Mineville District, New York	15.46	Gneissoid beds, limestone
Bunker Hill, Copper Creek District, Arizona	11.52	Five-sixths of ground fair, balance a hard diorite
Bisbee Queen, Bisbee mining district, Arizona	12.98	Medium hard limestone
Tintic Standard, Eureka, Utah	13.78	Limestone

*An 8x8-ft. main haulage drift.

Volume Changes of Gypsum Fiber Concrete*

By H. F. McMurdie and F. L. Marsh

Editorial Abstract

IN ORDER to study the volume changes of neat gypsum and gypsum fiber concrete, specimens were made from five different calcined gypsums. Types of concrete containing 3, 10 and 12.5% wood chips were prepared as well as neat specimens. Measurements were made of the expansions which occurred during setting and subsequently due to changes in moisture content. The thermal expansions were determined for specimens of one gypsum. The effects of the amounts of mixing water and of wood chips on the magnitude of these changes were investigated.

I. Introduction

GYPSUM FIBER CONCRETE is the term applied to a hardened conglomerate mass resulting from the setting of a mixture of calcined gypsum, wood chips and water. Because of the advantages of lightness and quick set, gypsum fiber concrete has met with favor for precast and poured-in-place floors and roofs, where it is used in much the same manner as portland cement concrete.

Since the necessary data on which building code requirements might be based were incomplete, Committee C-11 (on gypsum) of the American Society for Testing Materials appointed a subcommittee to cooperate with the bureau to obtain additional data. The first phase of this study was concerned with strength and related properties and a report on this phase was published as an appendix to the 1930 annual report of Committee C-11 under the title "Properties of Gypsum Fiber Concrete."[1]

For proper design information, a knowledge of the magnitude of the volume changes of gypsum fiber concrete upon wetting and drying is desirable since there is no assurance that the gypsum fiber concrete will always remain dry even though it is not directly exposed to the action of the weather. Accordingly the second phase of this investigation was undertaken to study the volume changes which occur as the concrete sets and those which may result subsequently from variations in the moisture content. The coefficient of thermal expansion was also determined.

The volume changes during setting have been determined by various investigators.[2-3] Less data are available on the changes which take place subsequent to setting caused by variation in temperature and moisture content.[4]

II. Materials and Mixes

Five different kinds of calcined gypsums were used in this work, as follows:

(1) Iowa gaging plaster.
(2) Rotary calcined gypsum.
(3) Tube milled stucco.
(4) Nova Scotia gaging plaster.
(5) Precipitated gypsum.

The physical and chemical properties of these plasters are given in Table 1.

The wood fiber or chips were kiln-dried soft pine planer shavings. Most of the shavings were less than 1 in. in greatest dimension and about 1/16 in. thick.

The nomenclature used in this report in expressing the composition of the concrete consists of three figures representing, respectively, the parts by weight of calcined gypsum, wood chips, and water. For example, 97-3-60 represents a mixture of 97 parts of calcined gypsum, 3 parts of wood chips, and 60 parts of water.

Two general types of gypsum fiber concrete are in use. One contains 3% by weight of wood chips and the other approximately 12½%. This investigation covers both of these types and a few tests were made on mixes containing 10% wood chips. In addition some tests were made with neat gypsum mixes to determine the properties of the gypsum itself.

III. Test Procedure

A. Expansion during setting

Specimens 4 by 1 by 12 in. were used. This size was found to give good distribution of the aggregate and was of such a size and shape that the specimens could be heated or cooled quickly and dried out within a reasonable time after soaking.

The apparatus used in casting the specimens and measuring the expansion during setting is shown in Fig. 1. A brass plate forms a base for the specimen. The mold is bisected diagonally, one-half being screwed firmly to the base while the other half is free to move. In the photograph the near side and the end toward the dial make up the movable half of the mold. The stem of the micrometer dial (reading to 0.0001 in.) passes through a hole in the mold and rests against a small glass plate placed in position before the mixture is poured into the mold. The end of the screw at the left in the photograph also passes through the mold and rests against a glass plate.

In preparation for a determination the mold and base plate were greased and the small glass plates put in place. The movable half of the mold was held rigidly by small clamps and the stem of the dial temporarily held back from the plate by a rubber band. The calcined gypsum and wood chips were weighed out and well mixed in the dry state. The mixture was then poured into a measured quantity of water contained in a mixing pan and the contents were allowed to soak for 1½ minutes, after which the materials were thoroughly mixed by hand, using rubber gloves.

The mix was then poured into the mold and a majority of the specimens had brass plugs (used for subsequent measurements) inserted 10 in. apart as seen in the photo-

TABLE 1. PHYSICAL AND CHEMICAL PROPERTIES OF THE PLASTERS USED

	No. 1 Iowa gaging plaster	No. 2 Rotary calcined gypsum	No. 3 Tube milled stucco	No. 4 Nova Scotia gaging plaster	No. 5 Precipitated gypsum
Chemical analysis					
H_2O (loss at 220 deg. C.), per cent	6.0	4.2	6.0	5.6	5.9
SiO_2, per cent	0.4	11.1	4.3	0.6	5.7
CaO, per cent	38.5	32.2	37.1	38.8	36.4
SO_3, per cent	55.0	38.8	51.8	53.5	49.8
R_2O_3, per cent	0.2	1.9	0.4	0.2	0.5
MgO, per cent	.....	3.8	0.4	.....	Trace
P_2O_5, per cent	.....	.....	.....	.....	1.4
Total	100.1	98.9	100.0	98.7	99.7
$CaSO_4 \cdot \frac{1}{2}H_2O$ (calculated from H_2O content), pct	96.7	67.7	96.7	90.2	95.0
$CaSO_4 \cdot \frac{1}{2}H_2O$ (calculated from CaO content), pct	99.7	83.4	96.1	100.5	94.3
$CaSO_4 \cdot \frac{1}{2}H_2O$ (calculated from SO_3 content), pct	99.6	70.2	93.8	96.8	90.1
Fineness (with standard sieves)					
On No. 14, per cent	0.0	0.5	0.1	0.0	0.6
Through No. 14, on No. 30, per cent	0.0	1.2	0.6	0.6	0.5
Through No. 30, on No. 50, per cent	0.2	3.6	0.4	2.8	0.9
Through No. 50, on No. 100, per cent	8.5	12.6	16.8	10.7	13.2
Through No. 100, on No. 200, per cent	33.6	13.4	23.8	13.4	23.9
Through No. 200, per cent	57.7	71.2	57.2	72.6	60.8
Testing consistency, per cent	43	45	50	53	73
Time of set, minutes	15	17	15	19	11
Tensile strength, lb./in.²	340	280	290	310	200
Compressive strength, lb./in.²	2640	2190	2000	2800	1250

All tests were made in accordance with the "Standard Methods of Testing Gypsum and Gypsum Products" as formulated by the American Society for Testing Materials (American Society for Testing Materials Standards, Part II, p. 125, 1930).

*Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

[1]Proceedings of the 33rd Annual Meeting American Society for Testing Materials, Vol. 30, Part I, p. 719, 1930.

[2]Porter, J. Miller, Volumetric Changes of Gypsum; Proc. A. S. T. M., Vol. 23, Part 1, p. 244 (1923).

[3]Murray, J. A., The Expansion During Setting of a Calcined Gypsum; ROCK PRODUCTS, p. 88, January 21, 1928.

[4]White, Alfred H., Volume Changes in Gypsum Structures Due to Atmospheric Humidity; Dept. of Eng. Research, Univ. of Michigan (February, 1926).

graph. A thermometer, with the bulb wrapped in tin foil to facilitate subsequent removal, was placed in the center of the specimen. At the end of six minutes, counting from the time the gypsum was placed in the water, the movable half of the mold was released and the stem of the dial allowed to rest on the glass plate by removing the rubber band mentioned above. Readings of the dial and thermometer were made every minute for the first 30 minutes and at somewhat greater intervals from then on until 90 minutes had elapsed, after which the specimen was removed from the mold. Expansion was measured from the shortest reading obtained, which in some cases was not the first reading because of a slight movement of the hardening plaster caused by the pressure of the dial stem exerted against the glass plate.

It is realized that the expansion does not necessarily stop in 90 minutes and, therefore, in most cases additional measurements were made with a strain gage after the specimens had aged for 24 hours in an air-tight chamber. This additional "expansion," while truly a part of the expansion during setting, will be considered under the section entitled "Expansion during drying."

B. Thermal Expansion

The specimens of rotary calcined gypsum only were used for the determination of thermal expansion. The same apparatus was used for measuring thermal changes as was used for the determination of the expansion during setting. The movable half was removed and the apparatus placed at an angle of 60 deg., with the dial at the high end, in a constant temperature cabinet held at 27 deg. C. and containing pans of anhydrous $CaCl_2$ to maintain the humidity constant.

A second cabinet was held at 47 deg. C. The specimens to be measured were placed in this higher temperature cabinet for about two days. The temperatures of the specimens were measured by a thermometer placed in a hole bored into the side of the specimen and extending to the center. A specimen was quickly removed and put in the expansion apparatus in the lower temperature cabinet and a reading taken at once. This process required about three seconds. The specimen was left in the instrument for several hours or until the temperature was the same inside and outside the specimen. The length was then again read and recorded. From the changes in length and in temperature the coefficients of expansion were calculated.

C. Changes Due to Variations of Moisture Content

Measurements of length changes after setting (except thermal changes) were made by means of a 10-in. strain gage. The brass plugs cast in the specimen, as shown in Fig. 1, were used to measure the changes during drying and those due to variation of humidity, but additional plugs were set in the edges of the specimens with litharge-glycerin cement for the measurement of changes due to alternate soaking and drying. Each plug contained a 1.4-mm countersunk hole into which the points of the strain gage could be inserted. The dial on the strain gage read to 0.0001 in. and all readings were compared to a reading taken at the same time on an Invar steel bar.

1. Changes During Drying

With those specimens which had the brass plugs cast in them it was possible to measure the length of the specimens at the end of the 90 minute setting period with the strain gage concurrently with the last reading of the dial in the apparatus used for the determination of expansion during setting. Thus, by correlating the reading of the strain gage with that of the dial, a complete record of all changes in length was obtained.

After being removed from the mold the specimen was at once placed in a small air-tight cabinet for 24 hours. This prevented drying out. After measuring it was allowed to dry out for one week in the laboratory, measurements being taken each day. After this each specimen was placed for a week in a cabinet controlled at 30 deg. C. and 25 to 30% relative humidity. At the end of this time it was again measured. After this measurement the specimens were stored on the laboratory shelves for several weeks prior to determining the effects of variation in the moisture content subsequent to initial drying.

2. Changes Due to Alternate Soaking and Drying

The specimens were divided into two groups, three of each mix being put in each group. One group was used for wet-dry cycles, while the other was used for alternate low and high humidity cycles.

The following cycle was decided on after some preliminary tests made with some of the rotary calcined specimens: Each specimen was dried for at least a week in a cabinet controlled at 30 deg. C. and 25 to 30% relative humidity. After measuring and recording the length it was totally submerged for one week in water saturated with respect to gypsum at 30 deg. C. and remeasured. The specimens were then removed from the water and allowed to partially dry in the laboratory air for a week or more before they were again placed in the drying cabinet for the next cycle. Each specimen of this group underwent 14 of these cycles.

3. Changes Due to Exposure to Alternate High and Low Humidity

The remaining three specimens of each mix were subjected to the following cycle: Each specimen was dried for a week in a cabinet controlled at 30 deg. C. and 25 to 30% relative humidity. It was then measured and placed for one week in a second cabinet maintained at 30 deg. C. and 85 to 90% relative humidity. After measuring the specimen the cycle was repeated. As the weather became very warm during the summer the cycles were suspended for about 10 weeks because it was impossible to hold the

Outline

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II. Materials and mixes.
III. Test procedure.
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- *B. Thermal expansion.*
- *C. Changes due to variations of moisture content.*
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IV. Results.
- *A. Expansion during setting.*
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- *C. Changes during drying.*
- *D. Changes due to alternate soaking and drying.*
- *E. Changes due to exposure to alternate high and low humidity.*

V. Summary.

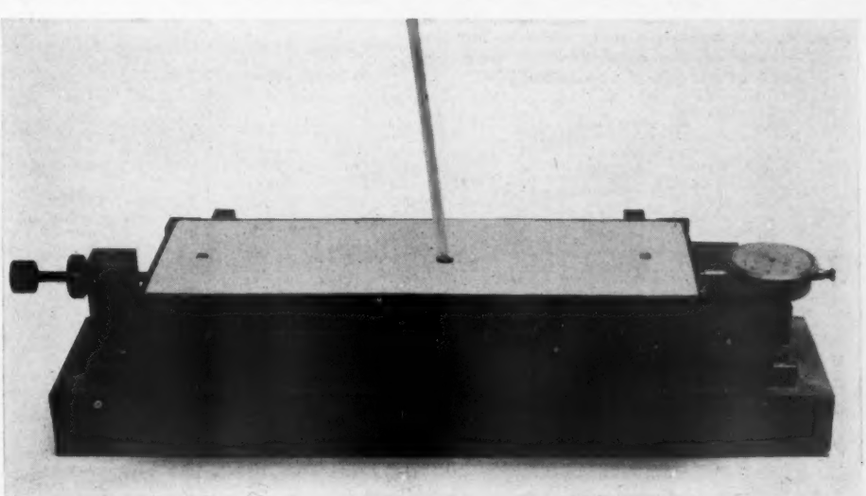


Fig. 1. Apparatus used in measuring volume changes of gypsum specimens

cabinets at 30 deg. C. As it was found that the changes were comparatively small, only 10 cycles were completed.

IV. Results

A. Expansion during setting

Table 2 gives the maximum, minimum and average percentage expansion values found with the various mixes made. The averages are for six specimens except as indicated in the table.

Sets H and II (Table 2) were made the same composition, but Mix II was made several months later and the plaster had changed in consistency. Set O was made several months before the other specimens of that plaster and during the intervening period the testing consistency had dropped from 58 to 48%. It is of interest to note that Set O and Set KK, both made at standard testing consistency, check very well in spite of the fact that the amount of water varied 10%.

Fig. 2 shows the expansion of a neat mix of each of the five plasters made up to standard testing consistency. It is seen that the expansion of rotary calcined gypsum is much greater than any other tested and that the precipitated gypsum is least. The difference in rate of the expansion between the plasters is also shown. This difference is again seen by comparison of Figs. 3 and 4 which show both the expansion and temperature rise of rotary calcined and precipitated gypsum. The peak temperature was reached at 25 minutes with the former and at 45 minutes with the latter, yet by the Vicat needle the time of sets are 17 and 11 minutes respectively.

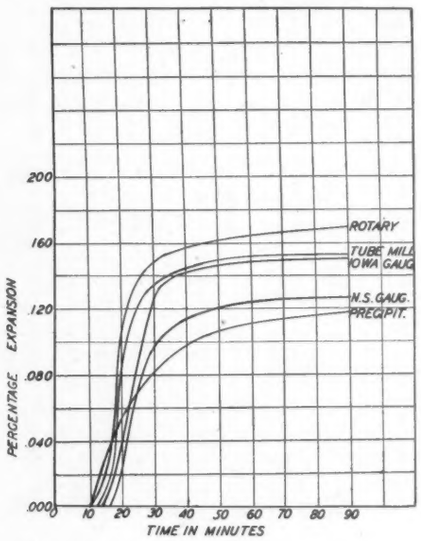


Fig. 2. Expansion during setting for neat mixes of the five plasters used, each at standard consistency

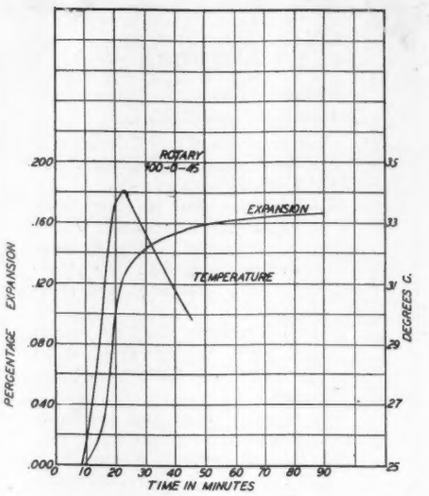


Fig. 3. Expansion during setting and time-temperature for neat rotary calcined gypsum

A wide range of neat mixes of two different plasters was made to determine the effect of varying the amount of mixing water. In Fig. 5 the expansion curves for four consistencies of neat rotary calcined gypsum are shown. The specimens made with 40% water expanded over four times as much as those which had 60%. Therefore, it is evident that a decrease in the amount of mixing water caused a distinct increase in expansion during setting.

A wide range of consistencies was also made with the gaging plaster. Fig. 6 shows the average "expansions on setting" plotted against the percentage mixing water. Here again a decrease in expansion is found to result from increasing the amount of water. The change, however, was not as great as with the rotary plaster. In this case 43% was "standard testing consistency."

Fig. 7 shows the expansion curves for four mixes made from rotary calcined gypsum, all of which contained 60% water but varying amounts of wood chips. Mixes containing a high amount of wood chips gave a higher percentage expansion. The mixes containing 12½ and 10% wood chips are much thicker in consistency than the neat mix made with the same percentage of water because the wood rapidly absorbs some of the water. Therefore, the increase in expansion is due in part, at least, to a reduction of the available water for the hydration of the calcined gypsum. The effect of the wood chips is not nearly as great, however, as is that caused by changing the amount of mixing water alone.

B. Thermal Expansion

The average, maximum and minimum values for the coefficient of thermal expansion of the various mixes are shown graphically in Fig. 8. The percentage of mixing water is indicated by the figure directly below each line.

The results indicate plainly that the thermal expansions decrease with increasing

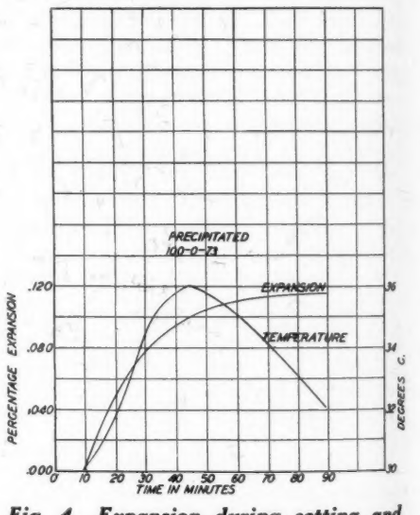


Fig. 4. Expansion during setting and time-temperature for neat precipitated gypsum

TABLE 2. MAXIMUM, MINIMUM AND AVERAGE EXPANSIONS DURING THE FIRST 90 MINUTES

Mix	Composition[1]	Kind of gypsum	Expansion Maximum Per cent.	Expansion Minimum Per cent.	Expansion Average Per cent.
I	100–0–40	Rotary	0.400	0.207	0.270
N	100–0–45	Rotary	.187	.158	.167
B	100–0–50	Rotary	.146	.111	.125
A	100–0–60	Rotary	.088	.079	.085
M	97–3–40	Rotary	.410	.235	.298
D	97–3–50	Rotary	.236	.133	.169
HH	97–3–55	Rotary	.131	.110	.120
C	97–3–60	Rotary	.133	.104	.122
F	90–10–60	Rotary	.149	.120	.136
E	90–10–70	Rotary	.098	.076	.088
K	90–10–80	Rotary	.099	.085	.090
H	87½–12½–60	Rotary	.179	.099	.140
II	87½–12½–60	Rotary	.096	.074	.088
G	87½–12½–70	Rotary	.135	.081	.103
J	87½–12½–80	Rotary	.086	.072	.079
L	87½–12½–90	Rotary	.117	.076	.093
KK	100–0–48	Tube milled stucco	.119	.112	.115
JJ	100–0–50	Tube milled stucco	.159	.148	.153
O	100–0–58	Tube milled stucco	.124	.114	.119
LL	97–3–60	Tube milled stucco	.130	.117	.122
MM	87½–12½–65	Tube milled stucco	0.131	0.086	0.102
P	100–0–53	Nova Scotia gaging	.134	.121	.128
Y	97–3–63	Nova Scotia gaging	.099	.085	.091
Z	87½–12½–68	Nova Scotia gaging	.086	.065	.075
V	100–0–73	Precipitated	.125	.083	.109
W	97–3–83	Precipitated	.145	.113	.127
X	87½–12½–88	Precipitated	.072	.058	.064
T	100–0–37	Iowa gaging	.193	.189	.191
R[2]	100–0–40	Iowa gaging	.156	.156	.156
FF[2]	100–0–41	Iowa gaging	.156	.150	.154
FF[2]	100–0–42	Iowa gaging	.152	.147	.150
Q	100–0–43	Iowa gaging	.149	.146	.147
EE	100–0–44	Iowa gaging	.156	.141	.146
GG	100–0–45	Iowa gaging	.140	.134	.136
S[2]	100–0–46	Iowa gaging	.127	.123	.125
R[2]	100–0–50	Iowa gaging	.118	.114	.116
S[2]	100–0–55	Iowa gaging	.115	.112	.113
AA	97–3–53	Iowa gaging	.116	.102	.107
BB	87½–12½–58	Iowa gaging	.093	.071	.078

[1]By weight respectively of gypsum chips and water.

[2]Average of three determinations. All others are the average of six determinations.

amounts of wood chips. The amount of mixing water used seems to have no significant effect on the thermal expansions.

C. Changes During Drying

The changes that took place during the period immediately after setting are given in Table 3 for representative mixes. The values are for the specimen of each mix which gave the intermediate length change. Column 4 gives the percentage expansion during the first 90 minutes. Column 5 shows the total expansion at the end of 24 hours, the specimen being stored as previously mentioned in an air-tight cabinet. The total percentage increase in length of the specimen after drying one week in the air of the laboratory is given in Column 6. The total percentage increase in length of the specimen after an additional week in air maintained at 30 deg. C. and a relative humidity of 25 to 30% is given in Column 7.

It seems evident from these values that the expansion during setting continues slowly, provided water remains in the pores of the concrete block. The contractions during the week of drying are about the same order of magnitude for all concretes except those made from the precipitated gypsum, which are less.

D. Changes Due to Alternate Wetting and Drying

Complete data were obtained for the volume changes during each cycle of wetting and drying. Since the inclusion of all these data is not warranted, sufficient values are given in Table 4 to indicate the general trend of the changes and the final values obtained. The values in Column 4 show the percentage change in length resulting from the first week of soaking, the reference point being the lengths of the specimens after the first oven drying. The following columns show the cumulative percentage change in length after successive cycles of drying and soaking. The specimens were allowed to stand in the laboratory air for three months after the last soaking before the final measurement shown in Column 9.

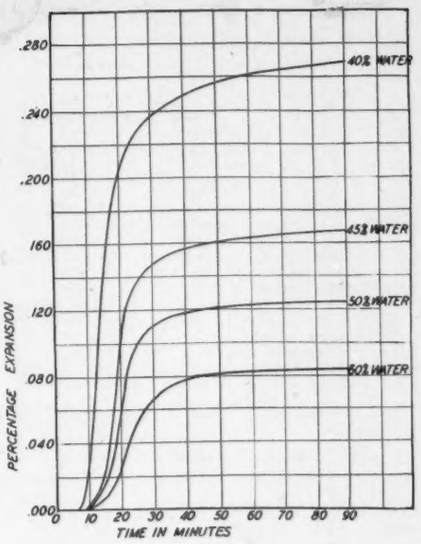


Fig. 5. Expansion during setting for four consistencies of neat rotary calcined gypsum

The specimens having a high percentage of wood chips show in all cases greater volume changes than those made from neat gypsum. From an examination of the data relative to the three neat specimens made with the Iowa gaging plaster, it is evident that a decrease in the per cent. of mixing water is accompanied by an increased expansion of the specimen upon soaking.

The complete volume changes for three typical specimens, including setting, drying and the wet-dry cycle changes, are shown graphically in Figs. 9, 10 and 11, which also contain corresponding data relative to humidity cycles which will be discussed later.

E. Changes Due to Exposure to Alternate High and Low Humidity

The data relative to the changes after the first air drying resulting from the exposure of the specimens alternately to air of high and low humidity are given in Table 5 in a manner similar to that used in Table 4, the reference point being the lengths of the specimens after the first oven drying. Likewise, the complete changes of typical specimens are shown graphically in Figs. 9, 10 and 11. It can thus be readily seen that the volume changes accompanying changes in the relative humidity of the air are much smaller than those effected by alternate wetting and drying. It is also seen that exposure to air of alternately high and low humidity caused in most cases a slight but definite decrease in length from cycle to cycle. This agrees with the results of

TABLE 3. CHANGES DURING DRYING

Mix	Kind of gypsum	Composition*	Increase in length: End of 90 min.	24 hr.	One week	One week at 30 deg. C. and 30% relative humidity
1	2	3	4	5	6	7
			Per cent.	Per cent.	Per cent.	Per cent.
HH 1	Rotary	97–3–55	0.131	0.159	0.129	0.136
II 1	Rotary	87½–12½–60	.096	.135	.075	.077
O 3	Tube milled stucco	100–0–58	.124	.133	.112	.102
LL 2	Tube milled stucco	97–3–60	.125	.143	.117	.115
MM 1	Tube milled stucco	87½–12½–65	.093	.113	.077	.063
P 3	Nova Scotia gaging	100–0–53	.126	.134	.109	.103
Y 2	Nova Scotia gaging	97–3–63	.091	.106	.078	.080
Z 3	Nova Scotia gaging	87½–12½–68	.086	.102	.069	.068
V 1	Precipitated	100–0–73	.119	.115	.107	.110
W 3	Precipitated	97–3–83	.123	.123	.115	.113
X 2	Precipitated	87½–12½–88	.062	.062	.035	.037
Q 2	Iowa gaging	100–0–43	.148	.147	.129	.132
AA 3	Iowa gaging	97–3–53	.116	.122	.111	.108
BB 3	Iowa gaging	87½–12½–58	.071	.087	.069	.058

*By weight respectively of gypsum, chips and water.

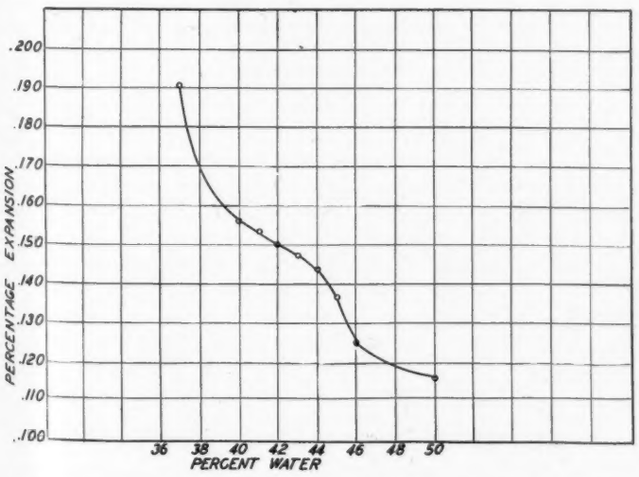


Fig. 6. Expansion during setting and percentage of mixing water for neat Iowa gauging plaster

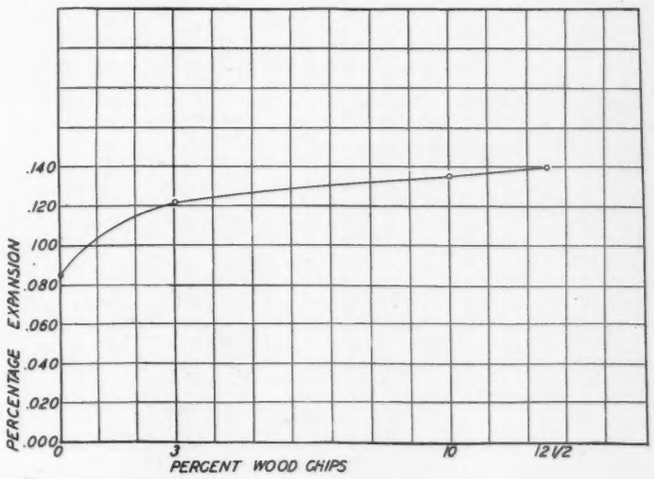


Fig. 7. Expansion during setting and percentage of wood chips used as aggregate

White.[5] J. H. van't Hoff and his coworkers[6] showed that the vapor pressure (or rather decomposition pressure) for the system $CaSO_4 \cdot 2H_2O$-$CaSO_4 \cdot \frac{1}{2}H_2O$-$H_2O$ is 12.7 mm. at 30 deg. C. The vapor pressure of water at the same temperature is 31.5 mm. It can thus be seen that the vapor pressure of the system $CaSO_4 \cdot 2H_2O$-$CaSO_4 \cdot \frac{1}{2}H_2O$-$H_2O$ at 30 deg. C. is 40.3% of that of water at the same temperature, from which it follows that $CaSO_4 \cdot 2H_2O$ would be dehydrated when the relative humidity of the surrounding air is less than 40.3% at 30 deg. C. Since the specimens were stored part of the time in air at 30 deg. C. with the relative humidity between 28 to 30% it is evident that the set gypsum was in an unstable environment, wherein dehydration could have occurred.

In order to see to what extent gypsum would lose water of crystallization when left in air of 28% relative humidity and at 30 deg. C., a sample of very pure gypsum was placed in air under these conditions and examined at intervals. It was found that the gypsum slowly lost water of crystallization (as determined by loss on ignition) and that at the end of three weeks this loss of combined water had reached 1.5%. That the rate is slow is to be expected since the moisture in the air corresponded to a vapor pressure of 8.8 mm., which is but 3.9 mm. less than 12.7 mm., the vapor pressure of the system $CaSO_4 \cdot 2H_2O$-$CaSO_4 \cdot \frac{1}{2}H_2O$-$H_2O$ at the same temperature. Nachen and Fill[7] have also shown that gypsum may be slowly calcined to anhydrite in very dry air at 20 deg. C.

Therefore, the fact that gypsum slowly loses combined water when maintained in air of 28 to 30% relative humidity at 30 deg. C. affords a plausible explanation of the slight decrease in length noted since a decrease might attend any loss of water of crystallization.

Several reasons may be assigned to the fact that the specimens undergoing cycles of alternate wetting and drying expanded from cycle to cycle. The expansion on wetting may have been the result of more complete hydration of the gypsum and crystal growth wherein larger crystals of gypsum were formed at the expense of smaller crystals. The wet-dry specimens, being so completely wetted during the week of soaking, probably never dried enough to have lost water of crystallization. The swelling of the wood chips on soaking undoubtedly accounted for the increased expansion of those specimens which contained them.

TABLE 4. CHANGES DUE TO ALTERNATE SOAKING AND DRYING

Specimen 1	Kind of gypsum 2	Composition* 3	Percentage change after 1st soaking 4	2nd drying 5	7th soaking 6	8th drying 7	14th soaking 8	Last drying 9
I 3	Rotary	100–0–40	+0.071	+0.026	+0.165	+0.136	+0.223	+0.193
A 3	Rotary	100–0–60	+.023	—.004	+.047	+.032	+.067	+.034
HH 3	Rotary	97–3–55	+.076	+.037	+.140	+.117	+.158	+.139
E 2	Rotary	90–10–70	+.103	+.043	+.194	+.153	+.249	+.217
II 1	Rotary	87½–12½–60	+.115	+.066	+.238	+.194	+.298	+.261
O 3	Tube milled stucco	100–0–58	+.067	+.036	+.077	+.058	+.063	+.052
LL 2	Tube milled stucco	97–3–60	+.073	+.038	+.098	+.073	+.101	+.080
MM 1	Tube milled stucco	87½–12½–65	+.116	+.044	+.194	+.156	+.218	+.194
P 3	Nova Scotia gaging	100–0–53	+.037	+.013	+.042	+.024	+.036	+.021
Y 2	Nova Scotia gaging	97–3–63	+.039	+.021	+.058	+.043	+.063	+.051
Z 3	Nova Scotia gaging	87½–12½–68	+.092	+.060	+.158	+.131	+.190	+.165
V 1	Precipitated	100–0–73	+.015	+.012	+.026	+.020	+.023	+.018
W 3	Precipitated	97–3–83	+.023	+.019	+.045	+.032	+.039	+.029
X 2	Precipitated	87½–12½–88	+.052	+.031	+.128	+.098	+.158	+.141
T 3	Iowa gaging	100–0–37	+.085	+.067	+.162	+.148	+.178	+.165
Q 2	Iowa gaging	100–0–43	+.042	+.033	+.085	+.070	+.087	+.076
R 3	Iowa gaging	100–0–50	+.036	+.027	+.069	+.059	+.070	+.060
AA 3	Iowa gaging	97–3–53	+.050	+.027	+.091	+.079	+.102	+.088
BB 3	Iowa gaging	87½–12½–58	+.098	+.069	+.242	+.220	+.315	+.294

*By weight respectively of gypsum, chips and water.

TABLE 5. CHANGES DUE TO EXPOSURE TO ALTERNATE HIGH AND LOW HUMIDITY

Specimen	Kind of gypsum	Composition*	Percentage change after 1st exposure to wet air†	2nd exposure to dry air	5th exposure to wet air	6th exposure to dry air	10th exposure to wet air
I 5	Rotary	100–0–40	+0.015	—0.003	—0.002	—0.012	—0.006
A 4	Rotary	100–0–60	+.012	+.003	.000	—.008	—.005
HH 4	Rotary	97–3–55	+.021	+.003	+.009	—.004	+.007
E 6	Rotary	90–10–70	+.035	+.009	+.030	+.007	+.030
II 5	Rotary	87½–12½–60	+.051	+.012	+.035	+.013	+.035
O 6	Tube milled stucco	100–0–58	+.014	+.005	+.005	—.009	+.002
LL 6	Tube milled stucco	97–3–60	+.015	+.002	+.004	—.010	+.007
MM 5	Tube milled stucco	87½–12½–65	+.034	+.002	+.019	—.001	+.020
P 6	Nova Scotia gaging	100–0–53	+.017	+.006	+.028	+.004	+.057
Y 5	Nova Scotia gaging	97–3–63	+.024	+.003	+.008	—.006	+.007
Z 6	Nova Scotia gaging	87½–12½–68	+.030	+.005	+.020	+.002	+.023
V 1	Precipitated	100–0–73	+.009	—.002	—.005	—.013	—.004
W 6	Precipitated	97–3–83	+.014	+.004	+.003	—.010	.000
X 5	Precipitated	87½–12½–88	+.034	+.003	+.020	+.005	+.023
FF 4	Iowa gaging	100–0–41	+.008	—.001	—.010	—.029	—.020
Q 6	Iowa gaging	100–0–43	+.010	—.005	—.010	—.023	—.017
S 5	Iowa gaging	100–0–55	+.009	+.001	—.002	—.017	—.010
AA 4	Iowa gaging	97–3–53	+.011	+.004	+.007	—.003	+.005
BB 4	Iowa gaging	87½–12½–58	+.029	+.009	+.024	+.005	+.028

*By weight respectively of gypsum, chips and water.
†Air of 85–90% humidity.

V. Summary

Measurements of the expansion "during setting" showed three main results:

1. Different plasters gave widely different expansions. The neat mix giving the highest expansion at testing consistency was 50% greater than the lowest under the same conditions.

2. The amount of mixing water had a very marked effect on the magnitude of the

[5] White, Alfred H.; Loc. cit.

[6] van't Hoff, J. H., Armstrong, E. F., Hinrichsen, W., Weigert, F., Just, G.; "Gypsum and Anhydrite," *Z. physik Chem.*, **45**, 257 (1908).

[7] Nachen, R., and Fill, K.; "Erscheinungen bei der Entwassening des Gipses," *Tonindustrie-Zeitung*, **55**, 1070 (1931).

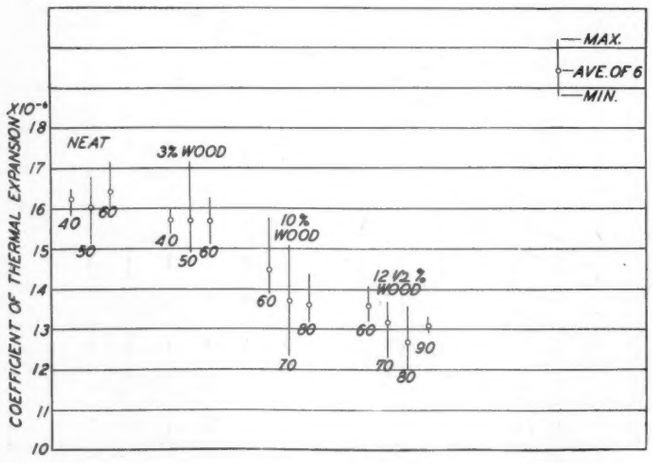


Fig. 8. Maximum, minimum and average coefficients of thermal expansion per deg. C. of rotary calcined gypsum. Figures below the lines are the percentages of water used

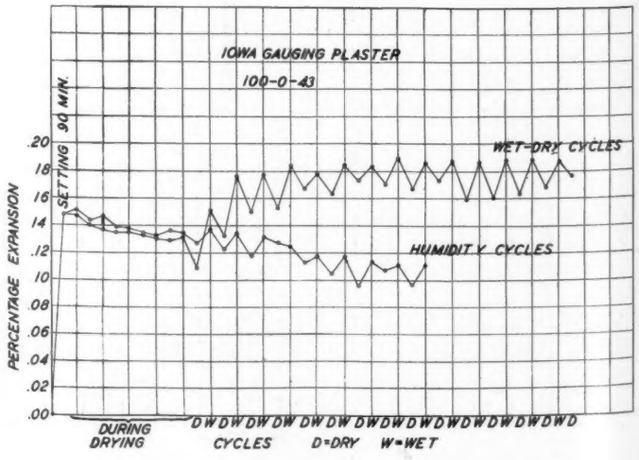


Fig. 9. Complete volumetric changes of specimens of neat Iowa gauging plaster

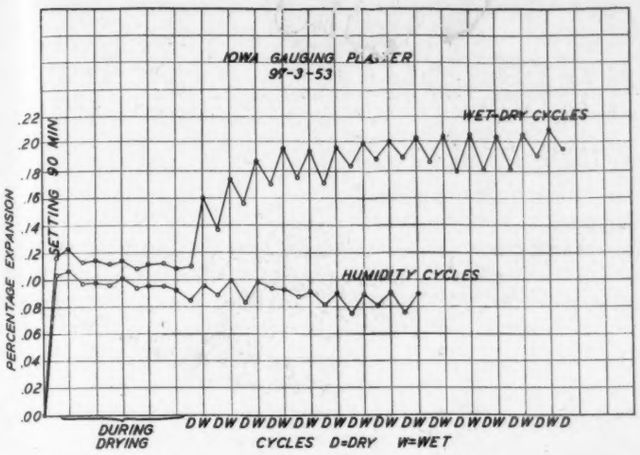


Fig. 10. Complete volumetric changes of specimens of Iowa gauging plaster with 3% wood chips

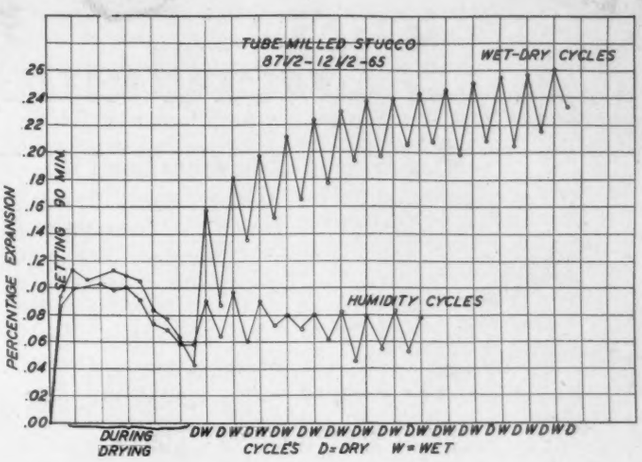


Fig. 11. Complete with volumetric changes of specimens of rotary calcined gypsum with 12 1/2% wood chips

expansion during setting. The more water used, the smaller the expansion.

3. Wood chips increased the expansion during setting if the percentage of water was held constant.

Determinations of the coefficient of thermal expansion on the specimens of rotary calcined gypsum gave three main results:

1. The measurement of thermal expansion made with specimens of one calcined gypsum showed that the coefficient of thermal expansion per deg. C. (27 deg. C. to 47 deg. C.) ranged from an average maximum of 16×10^{-6} for neat specimens to an average of 13×10^{-6} for specimens containing 12½% of wood chips.

2. The amount of mixing water used seemed to have little effect on the coefficient of thermal expansion of the hardened specimen.

3. The addition of wood chips decreased the thermal expansion of the specimens.

Measurement of the specimens during the week after casting showed that the expansion due to setting continued for at least 24 hours if the water was allowed to remain in the pores of the concrete. After that time a contraction in length took place when the specimens were allowed to dry out.

Determination of length changes during 14 cycles of wetting and drying and during 10 cycles of exposure to alternate high and low humidity gave the following information:

1. The continued alternate wetting and drying gave a gradual expansion from cycle to cycle.

2. Alternate exposures to air of high and low humidity produced a gradual contraction from cycle to cycle after the first few cycles.

3. The magnitude of the changes produced by soaking were much greater than those resulting from exposure to moist air.

4. Specimens of the same plaster made with a small percentage of water gave greater length changes during soaking than those in which a larger percentage of water was used.

5. Neat specimens showed much smaller length changes than specimens made with the same plaster containing wood chips.

Acknowledgments

The writers wish to extend their thanks and appreciation to J. A. Murray and Dr. L. S. Wells for many helpful suggestions and criticisms given by them during the course of the investigation.

Phosphate Rock in 1931

PRELIMINARY COMPILATIONS on the raw phosphate rock industry in 1931 indicate substantial declines in both mine production and shipments, according to a statement by the United States Bureau of Mines, Department of Commerce. Figures compiled from preliminary reports of producers in the United States in 1931 show a decrease of 35% in mine production, as compared with 1930. Shipments of phosphate rock in 1931 show decreases of about 36% in quantity and 35% in value, while total stocks increased about 27%.

Despite lessened demand, with resultant curtailment of production and shipments of phosphate rock in 1931, actual sales prices as well as quoted prices in trade journals were firm, and in general were equal to those of 1930. Encouraging signs of activity appeared at times in an otherwise dull market, but summation of conditions reveals that there was practically no new business in the raw phosphate rock industry during the year, and buying was confined largely to material under contract.

Total imports of crude phosphate rock into the United States for the first 11 months of 1931, amounted to 13,570 long tons, valued at $163,840.

Total exports of crude phosphate rock for the first 11 months of 1931 were reported to be 897,890 long tons, valued at $4,034,459.

Locating and Holding Mineral Claims

THE CALIFORNIA Department of Natural Resources division of mines has issued a publication, Manner of Locating and Holding Mineral Claims in California, bulletin 106.

This bulletin discusses the location of mining claims, the rights accruing thereunder, and the maintenance of those rights. This bulletin is a brief outline of bulletin 98, American Mining Law, by A. H. Ricketts.

PHOSPHATE ROCK MINED IN THE UNITED STATES IN 1931*

State	Mine production (Long tons)	Shipments (Long tons)	Shipments Value (Total)	Shipments Value (Average)	Stocks (Dry Long tons)	Stocks (Wet Long tons)
Florida:						
Hard rock	24,634	57,079	$ 371,015	$6.50	13,348	25,561
Land pebble	2,056,322	1,969,690	6,661,235	3.38	198,373	759,755
Soft rock	(†)	(†)	(†)	.....	(†)	(†)
1931	2,080,956	2,026,769	$7,032,250	$3.47	211,721	785,316
1930	3,261,539	3,248,071	10,790,305	3.32	186,675	611,304
Idaho (Western rock):						
1931	52,851	54,941	$ 201,180	$3.66	2,003	2,247
1930	64,129	59,932	234,543	3.91	1,890	161
Montana (Western rock):						
1931	66,078	66,078	$ 293,355	$4.44	.....	.....
1930	6,005	6,005	27,457	4.57	.....	.....
Tennessee (Brown and blue rock):						
1931	363,453	344,677	$1,558,858	$4.52	48,474	179,352
1930	618,341	611,045	2,938,525	4.81	51,872	116,308
Grand total, 1931	2,563,338	2,492,465	$9,085,643	$3.65	262,198	966,915
1930	3,951,353	3,926,392	13,996,830	3.56	240,526	728,219

*Figures for 1930 are final; figures for 1931 represent preliminary reports by producers covering 11 months actual operation plus an estimate for December.
†Included with land pebble.

Merchandising Sand

Producers Sand Co., Tulsa, Okla., Uses Slogan "Clean and Sharp as a Hound's Tooth"

By J. P. Doyle
Producers Sand Co., Tulsa, Okla.

THE PRODUCERS SAND CO., whose plant is at Gray, near Tulsa, Okla., has been engaged in the production and sale of Arkansas river sand since 1921. The market for its product, known as "Hound's Tooth Sand," is northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

The evolution of the term "Hound's Tooth Sand" is interesting. During the development of Oklahoma in the years following its admittance to the Union as a state (1907), and more especially in the busy years following the World war, the demand for construction materials was so great that almost every character of local aggregate was used. Oklahoma has innumerable scattered deposits of sand and gravel, of varying cleanliness and gradation. These deposits were all tried out by building contractors, road men and oil companies who were in need of concrete and plaster materials but the results were generally disappointing.

Coined by a Salesman

In making a call on a contractor during those busy days, a representative of the Producers Sand Co. was asked the usual question "Is the sand clean and sharp?"

Settling box used as an alternate method of loading

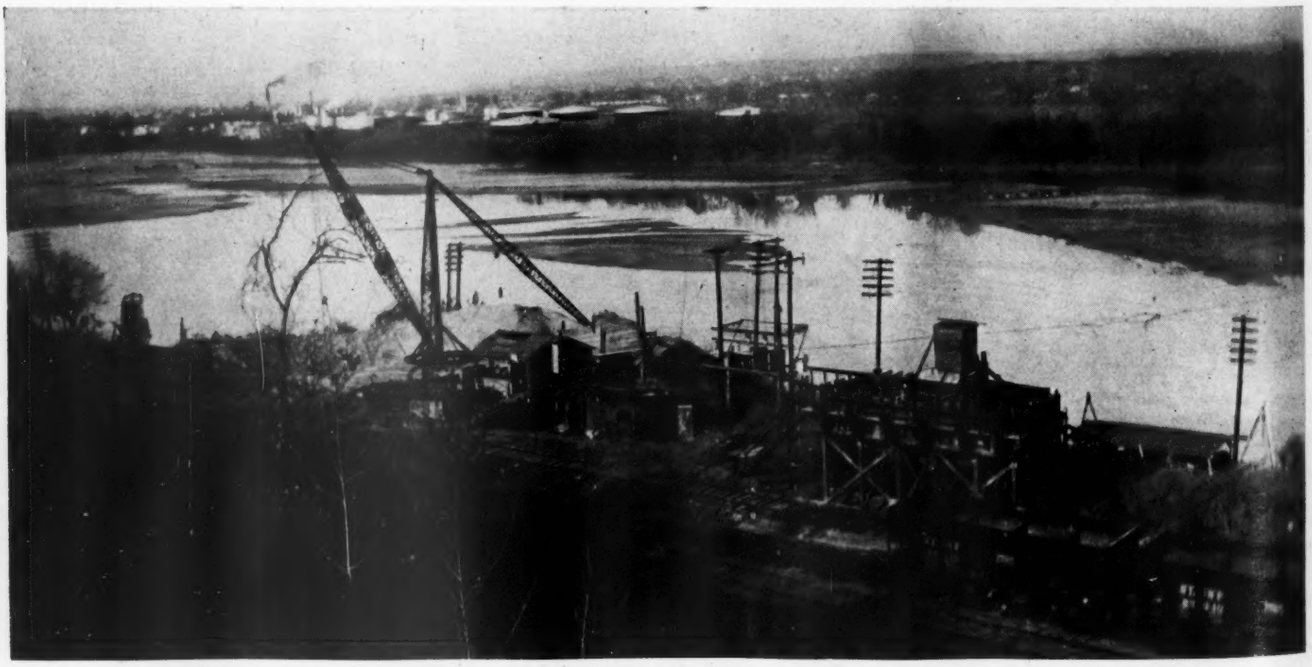
"Clean and sharp?," the salesman replied, "it's as clean and sharp as a hound's tooth!"

The name fastened itself to the product and to the company, and has been used for the past several years as a trademark. And it is a fitting name. Sand from the Arkansas river is sold successfully in competition with "Kaw River" sand from Kansas City, and other quality fine aggregates. It is used all over eastern Oklahoma at a premium in preference to the material from native deposits and "wayside pits."

For many years Arkansas river sand was used without screening, washing or classifying, as aggregate for the construction work in a large territory. In some cases settling boxes were used to remove foreign material, but for a long period of time bar sand shoveled into wagons was accepted as standard building and road sand, and structures built with this material testify that this unscreened, unwashed sand was good aggregate. The application of modern screening and washing methods to this excellent virgin deposit evolved a material worthy, in appearance and in fact, of the name "Hound's Tooth Sand."

Constantly Replenished Supply

To the layman, it is a source of wonder to see the quantity of sand, pumped from the Arkansas river at Tulsa and other points, which is loaded out in trucks and railroad cars for the trade, and then to observe that the sand in the river seems always at the same level. It is, certainly, an apparently inexhaustible supply, always fresh and clean. And the raw material, after screening out the oversize and perhaps some of the undersize sand, makes a product that is uniformly graded within close limits, "clean and sharp as a hound's tooth," all the year around.



General view of plant of Producers Sand Co. near Tulsa, Okla. Most of the sand is loaded by clamshell

The Plant

The original plant of the company has been modified as a result of the experience gained in the past ten years. It now consists of the boat and pump unit, dredge pipe on pontoons, wet screening system using flat screens set at a sharp angle, and concrete settling pit, from which the de-watered sand is loaded by clamshell either into the stock pile or direct into cars. This loading method is used on all orders where the customer recognizes the expense of excess water content. An alternate process involves pumping into an elevated settling box, after oversize screening and the wet sand, in this case, is allowed to flow directly into the cars through chutes. However, practically all of the sand is loaded by clamshell, as there is a general demand for de-watered sand. And it has its compensations, as the quality of railroad cars has been very low for some time. Sand loaded "wet" must be loaded into cars that are leak-proof, or nearly so, and this means that considerable labor and material must be used in preparing them for shipment. Stock-pile sand, on the other hand, can be loaded into almost any piece of equipment. Then, there is less overload or underload with clamshell-loaded cars, as the operator can estimate within 1 or 2 tons, the amount of sand he has loaded on a car, and can fill orders to the satisfaction of any contractor. A third advantage of stock-pile loading is the mixing of the sand in the settling pit or stock pile, making the loaded product more uniform in gradation. This practically eliminates rejections and the consequent expense of disposing of "distress" cars of sand.

Some rotary screens are in use on the Arkansas river, but they have not been found necessary by this company. The oversize screens at this plant are set at an angle of about 35 deg. from the perpendicular. The pump stream is first broken up on a ½-in. woven wire screen, under which is set a screen of ¼-in. hardware cloth. It has been proven that the larger screen which is constructed of ¼-in. diam. wire is better able to stand the concentrated flow, and will not clog. The sand gets an additional washing from the breaking-up action of the larger screen, and then has a better opportunity of passing through the ¼-in screen; consequently a high efficiency is obtained.

Sales Organization

When plaster sand or engine sand is required, a No. 8 or smaller screen is substituted for the ¼-in. These screens are all set in frames, which can be changed in the screen-guides in a few minutes.

The sales outlet for sand is either through the retail lumber dealers, or direct to contractors. The sales department maintains constant contact with all the lumber dealers in the territory, calling on them at regular intervals. In this way, the company is always aware of the kind of sand required at each point. Some dealers have a steady demand for concrete sand, which they are advised to stock; others cater to the plastering trade, in which event they are solicited for plaster sand business.

The sales organization aids the dealer in any sales where he may need help, such as selling a customer a plaster job instead of gypsum board for a new home, or helping a customer to estimate quantities for concrete or plastering contracts. Numerous occasions have arisen where the sales force is of real benefit to the lumber dealer, and a good turn of this kind goes far toward keeping a dealer's good will.

The above trademark (which is shown enlarged about four times) is used on all the company's stationery

Advertising is placed periodically in the local trade journals reporting construction work, in order to keep the name of "Hound Tooth Sand" before the buyers. In addition to this, direct-by-mail advertising is used.

Forging Ahead During Depression

IN THE LATE SUMMER of 1931 the Bureau of Foreign and Domestic Commerce undertook the collection of instances of business and industrial firms which have made material progress during the depression in maintaining or increasing sales volume or profits, and the policies or reasons for such progress.

Three hundred and fifty-eight examples, representing 202 manufacturing industries, 43 retail distributors and ten wholesalers, were examined and their policies are discussed in a bulletin, Forging ahead in Business.

Many examples could not be used in this study because their success was not a result of their own efforts but of a favorable demand caused by outside agencies.

In many cases, present success is attributed not so much to the present or a change in policy, as to past policies, the soundness of which is accentuated by current business conditions.

In a few instances, certain firms have been included whose profit experience has not been wholly successful but who have shown a definite plan of procedure to solve their problems, that appears to be sound and increasingly productive of good results.

The more important reasons or types of policies that 205 manufacturers and trades give for maintaining a successful record of sales or profits, as indicated by the members adopting them, are summarized below. Each figure represents the number of firms or industries that gave the indicated reason as aiding in their success.

Marketing	254
Sales efforts	46
Increased sales efforts	37
Advertising	80
Increased	29
Maintained	19
Market research	18
Management of salesmen	10
Cooperation with dealers	17
Analysis of sales cost	8
Improving service	10
Reduced prices	18
Product	91
Diversification	14
Modifying product to appeal to customers	17
Product research	11
New products	20
Quality of products	20
Production	59
Installation of modern equipment	14
Reduction of operating expense	24
Balanced production	9
Other policies—administrative	7

It will be seen from the above table that increased sales efforts and advertising policies are the most important reasons given by firms for their success. Market research, reduced prices, cooperation with dealers, improvement of service and management of salesmen occupy a prominent position in the marketing program of the companies. Of scarcely less importance are the policies dealing with new products, quality, research diversification and modification. In their production policies, firms have focused most of their attention on reduction of operating expenses and the installation of modern equipment.

Other reasons given but adopted by a relatively small number include increased sales force, extensive advertising, careful advertising, new uses of product, expansion of sales lines, increased sales outlets, specialization, purchasing, and reduction of overhead.

Lime and Slate in 1930

STATISTICS on lime and slate in 1930 have been published by the Bureau of Mines. The information in these bulletins will be included in part II of Mineral Resources of the United States.

Sand and Gravel Research to Date

Report of the Engineering and Research Division of the National Sand and Gravel Association

Reviewed by Edmund Shaw
Contributing Editor, Rock Products

AT THE Annual Convention of the National Sand and Gravel Association held in January, Stanton Walker, director of the Engineering and Research division, gave a summary of the division's activities. Much of this has already been published in Mr. Walker's review, ROCK PRODUCTS, January 9, p. 94-97. So this abstract will be mainly of the features of the report which were not treated so fully previously.

The engineering division is now six years old and it has had a laboratory for four years. It seems worth while to copy from the report the list of researches undertaken and their present status.

Present Research Activities

1 and 2. *Effect of Grading of Gravel on Voids and Weight,* has been published. Mr. Walker says it is expected to supplement the work by tests of void contents of various combinations of fine and coarse aggregates.

3. *Effect of Addition of Finer Sizes of Gravel on Strength of Concrete.* Report published.

4. *Investigation of Washed Gravel Ballast.* Data already published and more to be published in the 1931 A. R. E. A. report. Preliminary studies of testing for load resisting ability have been made.

5. *Special Investigations of Concrete Sands.* Discussed below.

6. *Effect of Flat Particles on Concrete-Making Properties of Gravel.* Published.

7. *Wear Tests of Concrete.* Preliminary tests made with Deval abrasion machine.

8. *Effect of Mineral Composition and Shape of Particle on Strength of Concrete.* Tests being made in groups, each group being tested against a material selected as standard. The reports say that while a large amount of work has been done on this series, it is not feasible to make a progress report at this time.

9. *Effect of Grading of Fine and Coarse Aggregate on Strength of Concrete.* Only preliminary studies made so far.

10. *Effect of Briquet Molding Pressure on Strength Ratio of Sand.* Preliminary tests. It is hoped the new A. S. T. M. method of testing sand will overcome some of the difficulties this series was designed to study.

New investigations are:

11. *Investigation of Method of Making Accelerated Sodium Sulphate Soundness Tests on Fine and Coarse Aggregate.* This is discussed in the January 9 issue of ROCK PRODUCTS and in this abstract.

12. *Effect of Quality of Cement on Comparisons of Concrete-Making of Aggregates.* Preliminary study discussed in the review and this abstract.

13. *Drainage Tests of Sands.* Study of water-carrying capacity discussed in both the review and this abstract. In addition to these the report discusses some special work undertaken for member companies which is of great interest.

Sodium Sulphate Test

The division's study of the sodium sulphate test has raised that much-discussed—and cussed—test to a real method of investigation. Its results are now not mere "indications" of the durability of an aggregate but actual values that can be checked by other laboratories having the equipment and trained workers. As explained in the review, the sources of error were found to be: lack of thorough preparation of the sample —improper sieving (the longer the present writer studies such matters the more he is impressed with the serious importance of thorough sizing whether it be in the laboratory or the plant); and lack of control of temperature. The means by which these sources of error were eliminated (very simple means) are fully described in the review mentioned. In the report being abstractd tables are given which show how closely tests on the same aggregate will check when the test is properly made. One of these tables is:

Table No. 1. Weighted Average, % Loss.

Lot No.	No. 1	No. 2	Differences
447	11.9	12.0	0.1
455	10.1	9.7	0.4
468	10.5	11.0	0.5
444	4.2	4.1	0.1
445	9.8	9.2	0.6
446	3.9	3.8	0.1
438	19.1	21.0	1.9
454	4.0	4.4	0.4
451	14.5	14.7	0.2
473	3.7	3.1	0.6
474	3.5	3.6	0.1
490	1.2	1.5	0.3
495	4.2	4.2	0.0
453	4.7	4.1	0.6
501	6.1	5.9	0.2
458	1.3	1.4	0.1

The checking in this case proves that the sodium sulphate test in proper hands is just as good as the sample. Anyone familiar with the structure of mineral particles would say that the variations would have to be fully as great as those shown in the third column. The entire concrete industry owes a debt of gratitude to the division for its work on this test—all the more necessary now that the test is part of specifications by which aggregates are accepted and rejected.

A second table shows tests on samples of sand from the same source. The percentages of loss were 9.44%, 8.52%, 9.81%, 11.75%, 10.8%. The average is 9.92% and the lowest (8.52%) is 86% of this and the highest (11.75%) is 117.5% of it. The others are very close checks, and again we may feel satisfied that the results are as good as the samples.

The division also tried magnesium sulphate in the place of sodium sulphate, with two other laboratories cooperating. The results show that magnesum sulphate (epsom salts) had about four times the disintegrating effect that sodium sulphate had on this sample. Since one cycle of sodium sulphate equals 5 to 12 cycles of freezing and thawing, and since the complaint against it is that it is too severe rather than too mild, it would seem unnecessary to seek an agent that is still more severe in its effects.

Design of Concrete Mixtures

As pointed out in the review in ROCK PRODUCTS, the growing practice of choosing aggregates for highway concrete by competition may work hardships to certain aggregate producers. The competition is carried on by making trial mixes. Such tests are usually made with a single arbitrarily chosen cement and do not take into account the factors listed in the review which may put one aggregate in a favorable and another in an unfavorable light.

The time of testing is one of these. The report says unavoidable differences in conditions due to testing at different times make a variation in strength equal to 1 sack of cement per cubic yard of concrete. There is no doubt about this. F. H. Jackson's paper delivered at this same convention gives figures which prove it and there are many others. The age at which tests are made is another factor. There is enough data to show that, with the same mix and cement, the aggregate which gives the greater strength in 7 days may give the lower strength in 28 days and that similar differences may appear when the 28 day and 3 mo. strengths are compared. The quality (not simply the strength-making property) of the cement may have an important effect. The report gives results on this with two aggregates and three cements. With a low testing standard portland cement one aggregate gave 109% of the flexural strength of the other. With a

high testing standard portland cement the same aggregate gave 122% of the strength of the other. With a special high early strength cement this aggregate gave 114% of the strength of the other. Now if these aggregates were to be given different cement factors to equalize the flexural strength, which would be chosen? The selection of the high standard percentage of 122% might cause a contractor to choose the higher priced aggregate with the greater strength because the difference in cement would be more than the difference in the price of aggregates. On the other hand if the increased cement factor was set on the test that showed 109%, he might find it much to his advantage to use the cheaper aggregate even though the cement factor was a little higher. This alone is enough to show that Mr. Walker is not splitting hairs or being unreasonable in any way when he criticises the competitive trial mixture method of selecting aggregates.

Tests of Sands

The most interesting test of sands noted is one made for a member company. The specification under which the sands were to be used limited the quantity of mixing water and there was danger that one sand might be rejected because of its higher water requirement. The tables show that for a four sack mix the average water requirement for all mixes with both gravel and stone as coarse aggregates was 1.34 for Sand A and 1.24 for Sand B, mixing to the same consistency. With a 6-sack mix the requirements were 0.85 for Sand A and 0.81 for Sand B. The sands appear to be as nearly identical as two sands from different sources could be. The fineness modulus was 2.55 for both and there was very little difference in the grading. The true specific gravities were 2.64 and 2.63 and both were essentially siliceous. The only difference was in the percentage of voids which was 31.8% for Sand A and 29.5% for Sand B. It is the reviewer's own opinion (based on work of some years ago on the moisture held up by drained sands and what Stanley Hands has told him of his work on the water requirements of aggregates) that this difference in voids would account for a part if not all of the higher water requirement of Sand A.

This matter of the water-carrying capacity, or water requirement of sand is beginning to be recognized as a factor of the utmost importance, not only in making concrete but in making lime and gypsum plasters. The report notes that the division has been carrying on tests on the effect of grading and other factors on the water-carrying capacity of sand and the results are now available in a paper by Mr. Proudley.

The report gives some very interesting tables showing the results of routine tests on gravels used as railroad ballast. The gravels came from 20 eastern, midwestern and southern states and the tables which give the physical tests afford interesting information about the gravels of the country. For instance chert is at present much out of favor because it has not only been found unsound by the sodium sulphate and the freezing and thawing test but because it has given a bad performance in some localities. Yet in this series of tests the only gravels that withstood seven cycles of sodium sulphate without any change whatever were one from Louisiana and one from Texas, both composed of chert and quartz. The Louisiana gravel gave a very good account of itself in the crushing test, next to the best in resistance, and it was the lowest but one in resistance to abrasion. So, evidently, it is as unsafe to generalize about aggregates as it is about other things. On the other hand a Missouri chert gravel (and many complaints of the behavior of chert have come from Missouri) suffered rather severely in the sodium sulphate tests. The gravel that suffered most contained argillaceous limestone and shale, both of which, of course, are notoriously nonresistant to such tests.

Research Activities Retained in Spite of Depression

Although 1931 is supposed to have been a year of great depression the tables showing the laboratory's work are evidence that the activities of the division were not diminished and also that they were appreciated as much as ever by the members of the Association. There were 3467 tests of all kinds made as against 2854 made in 1930. A slightly smaller number of samples was sent in from member companies and others, 99 as against 104, and there was one less in the number of member companies asking to have work done. Rather more than half of the samples submitted were sands.

Effect of Silica on Properties of Pottery Bodies

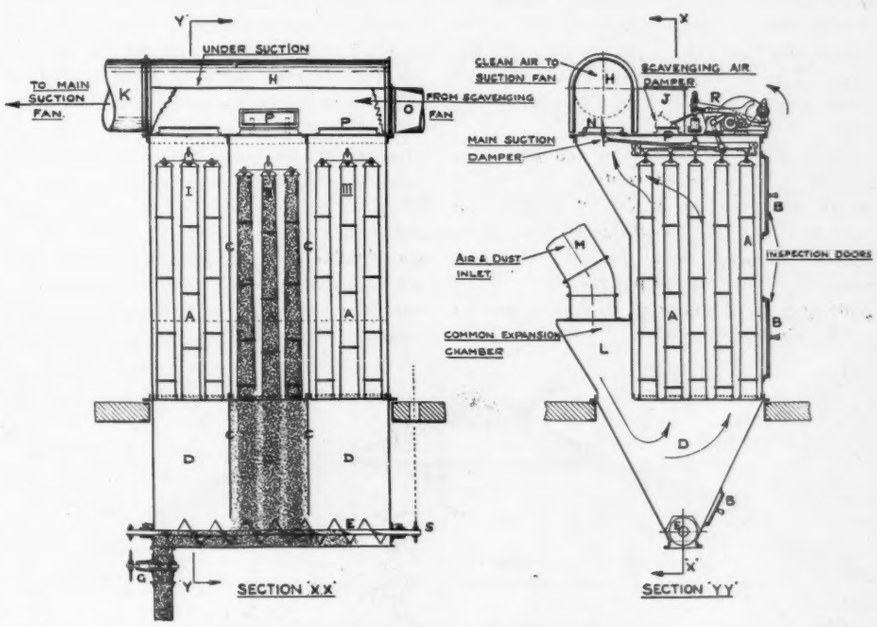
PRELIMINARY results of several years' study of the effect of various types of silica and flint on the ceramic properties of pottery bodies are presented in the Illinois State Geological Survey's Report of Investigations No. 24. The report is entitled "Progress Report on the Study of Southern Illinois Silica as a Pottery Material," and is by Prof. C. W. Parmelee, head of the department of ceramic engineering, University of Illinois.

The behavior of each of three types of silica—southern Illinois silica, quartz sand "flint," and French pebble flint—has been studied in three typical pottery compositions.

The results of the tests given should be of interest to producers and jobbers of silica and flint.

British Dust Collector

A DUST COLLECTOR with some new features is described in the British journal, *Crushing and Grinding*. It is of the cloth bag type with apparatus for cleaning automatically at stated periods. The air enters below the bags, which are cloth tubes in this device, and passes through them to a passage which connects with the suction of the fan. The tubular bags are in three compartments and each is cleaned in turn by blowing air on the outside of the tubes while they are being shaken. The outlet to the suction fan is shut off the compartment while this is being done, the air for cleaning or scavenging coming from a separate fan. The changing of the valves and shaking of the tubes is accomplished by the top operating gear, marked *R* in the cut. The collected dust is removed by a screw conveyor.



British dust collector with new features

How a Consulting Geologist Saves Producers' Cash

A Few Specific Examples of Money Lost and Money Saved

By Harold C. Whitnall
Professor of Geology, Colgate University, Hamilton, N. Y.

FOR MANY YEARS the mining geologist has been an essential member of the mining industry. More recently the petroleum geologist has established a vital place for himself in the oil and gas industry. But it has only been within recent years that the need of a consultant in general geology has been recognized.

True, many of the larger dam-sites and other large construction projects have had the benefit of geological advice and many pitfalls which would have led to financial disaster have been avoided. But it is also true that in the great majority of instances where a geologist would be equally helpful he is frequently overlooked entirely.

Consider the quarry operator, or others, who excavate rock. There are thousands of men engaged in this kind of work and the annual costs run into billions. Most of them have no knowledge of the geology of the site or the region wherein the work lies. They study the plan of the engineer or architect and have little information about the material they may encounter during the excavation. When in doubt they drill, indeed it may be stipulated that borings be made, to determine the character of the material beneath the surface. But the drill-log may be misleading unless interpreted by a competent geologist. For example, a boulder bit into by the drill may give a false impression that solid rock has been encountered. The geologist, by examining the drill chips, knows whether it is a boulder or bed rock.

Even more essential is a geologist to a builder who is under contract to erect a heavy structure on incoherent material as sand or clay. His knowledge of the permeability, porosity, and dip of the loose material, as well as the position of the water table may be of enormous value and prevent much subsequent grief.

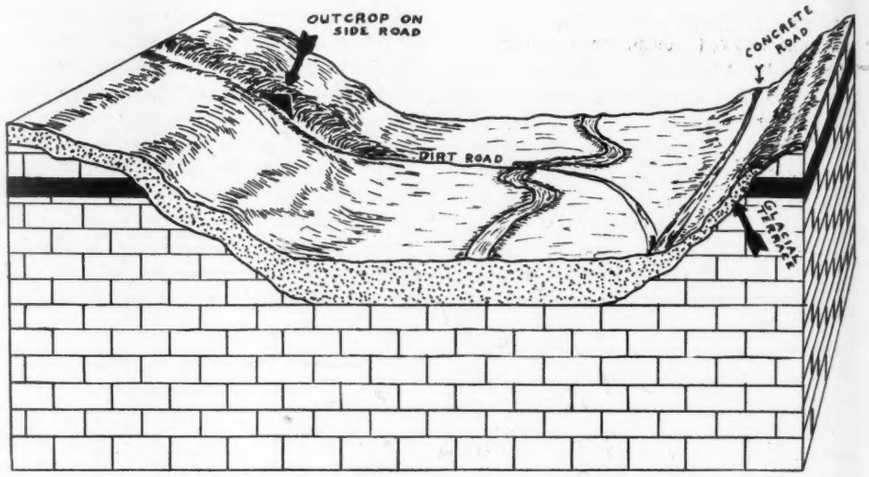


Fig. 1. Showing how a geological examination would have saved a large amount on a road job

Many other generalizations could be given which would clearly show the value of a consultant in geology. A number of specific examples taken from the writer's own note book showing where the employment of a geologist could have or did prevent a great waste of money are given in the following illustrations.

It was desired to open a quarry for the construction of a concrete highway, where a certain limestone was permitted for the crushed stone. Much to his delight the prospective quarry operator discovered, three miles from the beginning of the job, a limestone that met the specifications. The outcrop was located on a hillside along a dirt road. The rock was exposed at a height of 40 ft. above the poor and often muddy side road. The quarry operator erected at a considerable cost and labor his crusher and trucked the material three miles over a road that was soft and often miry. This meant a nine mile haul to the end of his job or a six mile truck to the middle. Yet he was pleased with his discovery.

Had he called in a geologist he would have learned that the same strata which he was quarrying and crushing on the hillside lay along the road he was furnishing aggregate for, and at the middle of the contract the limestone was just above the road and within 100 ft. of the highway, but was masked by a narrow glacial terrace. The amount saved to the producer would have amounted to thousands of dollars had he spent a hundred of it for a geological reconnaissance. The geology of the region is illustrated in Fig. 1.

Another illustration: The specifications of a new highway called for a reduced grade over a low hill. This meant that the upper portion of the hill would have to be excavated and stripped. The contractor dug a shallow hole to learn the character of the underlying material. He found that it was a very friable shale that could easily be removed with a shovel and scraper. He figured on the job believing that the soft material extended well downward. When he had scraped off the top 2 ft. and found that he had still 10 ft. to go, a hard dense limestone was encountered, which required blasting and quarrying operations. The unexpected expense forced him into bankruptcy. A geologist could have told him from an examination of the shale and its fossil contents that it represented the lowest strata of a soft fissile shale, and that within

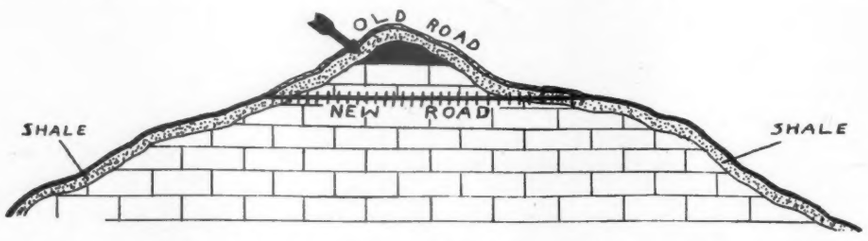


Fig. 2. Another road job at which considerable would have been saved by a geological examination

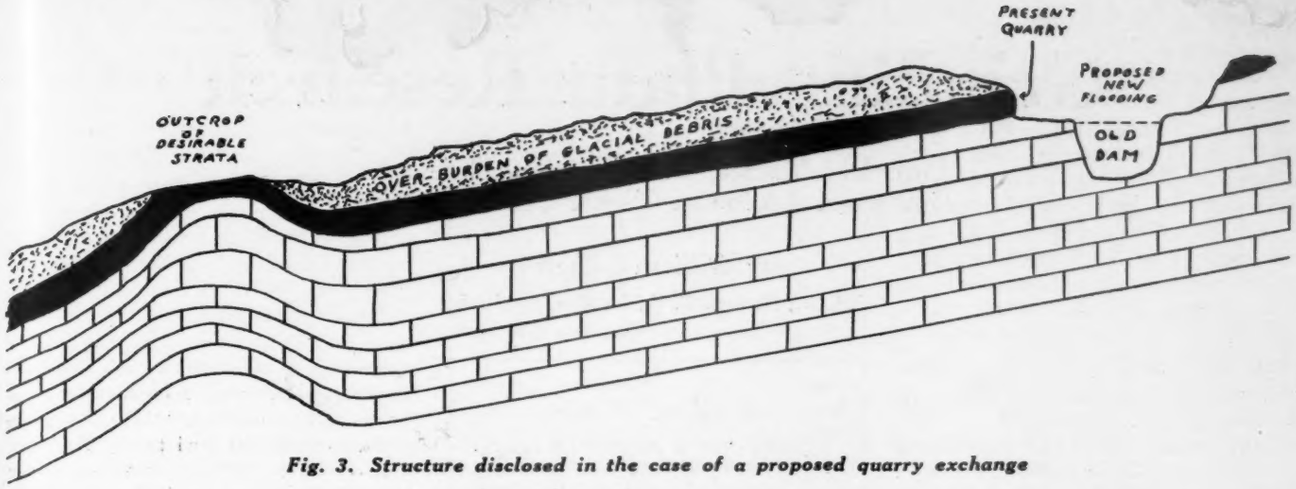


Fig. 3. Structure disclosed in the case of a proposed quarry exchange

a few feet a hard limestone would be encountered. Fig. 2 represents the geological conditions.

Investigate Before Opening Quarry

A power company wished to enlarge the flood area of its dam. This meant that a quarry producing a high grade limestone used for agricultural purposes must be flooded. The owners of the quarry agreed to give up the property provided the power company would get them another site in the neighborhood that would show the same excellent strata of limestone.

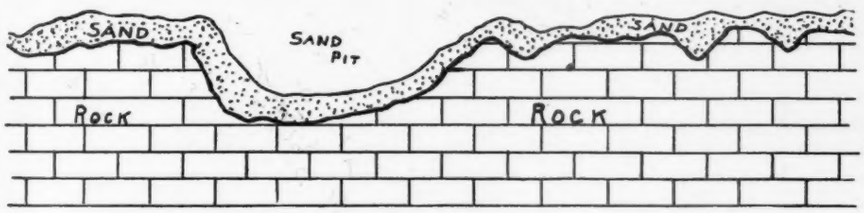


Fig. 4. Showing results of a geological survey of sand resources

Representatives of both parties scouted the vicinity and found at no great distance a surface exposure of the desirable rock. It lay for a short distance on the surface and apparently had the same gentle dip, and even the same fossils, as the beds in the original quarry. Unquestionably it was the same horizon and there seemed to be no doubt as to the advisability of erecting the new plant there.

But inasmuch as the power company had guaranteed that the new quarry was to have as great a cubic volume as the old and that it could be operated as cheaply as the original, their head engineer called in a consulting geologist to check the situation so that there would be little chance for a future litigation.

The geologist, knowing that surface indications are often deceptive, spent two days in the vicinity. He found that it was a region in which the strata had been folded and faulted with a consequent disturbance and displacement of the strata from the horizontal. He suggested that the soil be removed from each side of the outcrop for a short distance. The removal of the overburden showed the structure illustrated in Fig. 3. The folding had thrown the strata upward into a fairly flat topped anticline or folded ridge, giving to the outcrop the appearance of being a continuation of the horizontal trend of the beds as exposed in the old quarry. The extent of the overburden on each side of the ridge and the sharp dip of the strata was so great that it would have been an expensive proposition to have stripped it and a difficult task to have mined it as easily as the old quarry. Had the exchange taken place the power company would have been liable for heavy costs.

Wrong Guess on Sand Resources

A small producer wished to control a number of sand pits along a railroad. One of his competitors had mined for a number of years sand from a seemingly inexhaustible pit. The owner held large acreage radiating in all directions from the pit, and surface conditions were such as to cause one to believe that the area was a continuation of an extensive sand plain. The prospective buyer had a survey made under the direction of a geologist and found that the conditions were as shown in Fig. 4.

The nearness and ruggedness of the underlying rock had been completely masked by a glacial sand plain of large extent, but of variable thickness. The workable area had been found by mere chance. Its owner and operator had no idea that the sand was so nearly worked out, and that the sand in other portions of his holdings was of so little importance.

Such illustrations could be multiplied many times, but they will serve as examples of the need of geological information in nearly all cases which involve material lying below the surface.

Cheap Indian Crushed Granite Enters European Market

A LARGE EXHIBIT of crushed granite road stone by the Mysore government, India, was shown at the recent International Public Works, Roads and Transport Congress in London, England. Inquiries showed that shipments have been made to Europe at intervals during the past six months.

The wage cost of quarrying is trifling in India, due to the employment of native labor, and by sending the granite as ballast in tramp steamers it can be landed in the United Kingdom, it is claimed, at a cheaper price than Norwegian granite. This new development is expected to intensify the competition in the European stone market.

Finds Deposit of Pure Barium Silicate

THE FIRST barium silicate to be found in its pure state has been identified by A. F. Rogers, head of the mineralogy department at Stanford University, and given the name Sanbornite, in honor of Frank Sanborn, determinative mineralogist of the California Bureau of Mines.

This is the 36th new mineral found in California since 1860, and although pure barium silicate has been crystallized in the geo-physical laboratory at Washington, this discovery is said to be the first of the raw material.—*Elizabeth* (N. J.) *Journal.*

Mineral Production of Canada

A PRELIMINARY REPORT on the mineral production of Canada during the year 1931 has been published by the Dominion Bureau of Statistics. It provides in detail the first figures on production for the whole of the calendar year with comparative figures for the preceding year.

Grinding Plant Research

Part III—Method of Obtaining Reference Curve and Additional Clinker Grinding Tests

By William Gilbert
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THE REFERENCE CURVE, a portion of which is shown at *ABCD* in Fig. 15, has been obtained by grinding Leighton Buzzard standard sand, in an experimental mill, which was 18 in. in diameter, and 18 in. long (inside the lining plates).

This standard sand is a uniformly hard material which passes a 20-mesh sieve and is retained on a 30-mesh sieve. The mill was lined with cast-iron plates provided with lifter bars. The grinding bodies (300 lb. of 1-in. diam. steel balls) and 48.8 lb. of standard sand, were put into the mill through a suitable opening, which was then closed by a flush door. The grinding bodies occupied 40% of the mill volume, and the ratio of the sand volume to the volume of the voids, was 115% at the beginning of the test.

The mill was rotated at a uniform speed of 47 r.p.m. (speed factor Sf = 193). The test was divided up into a number of periods; first, of 150, and later of 300 revolutions. At the end of each period the mill was stopped, and a sample taken for sieve tests.

Editors' Note

IN PREVIOUS ARTICLES fundamentals of tube mill grinding and part of the test results were given. The present article shows how the power reference curve was obtained and gives additional test results along with a table of various test data. A comparison is made of these results.—The Editors.

The result is shown by the curve *ABC* on Fig. 16, which gives the residue on 180 mesh throughout the test. The sand was finally ground to a residue of 5%, which is represented by the ordinate *EC*. The base line *DE* represents to scale either the number of mill revolutions, or the power required, to grind the sand to any degree of fineness within the limits of the curve. In this case the power required to grind the sand to the 5% residue is taken at 100. It will be seen (for example) that, when the power expanded was 50%, the residue on 180 mesh was 33.4%. It will be seen that a regular curve was obtained, although there were small irregularities during the early stages of the grinding.

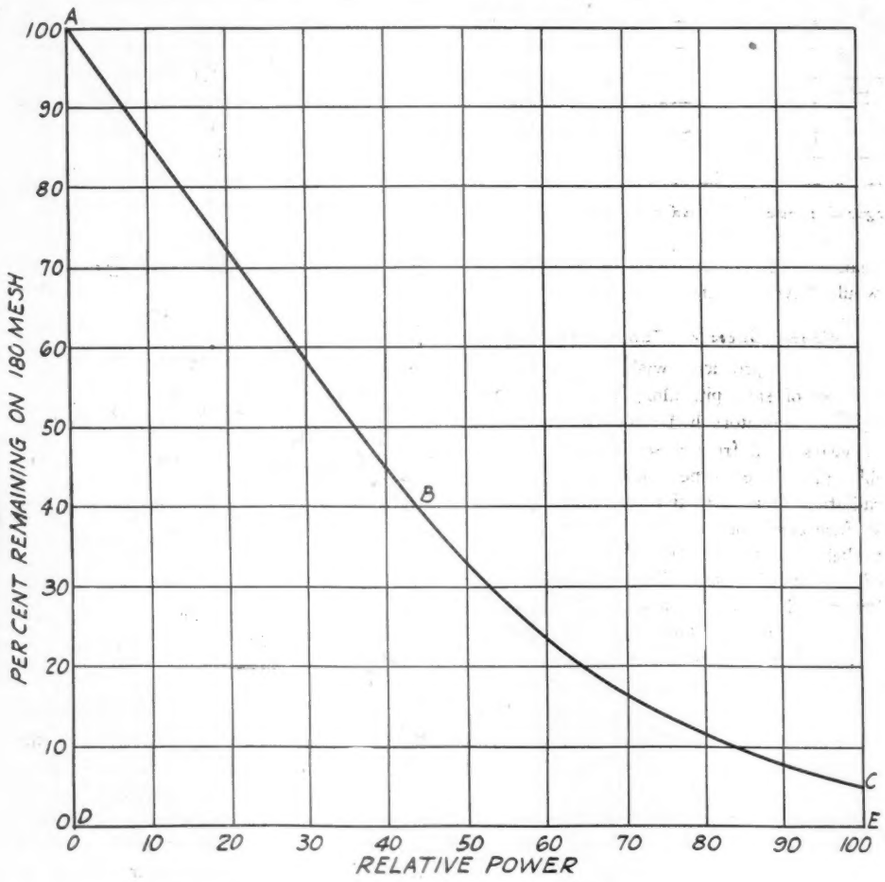


Fig. 16. Reference curve obtained by grinding standard sand

The curve is not necessarily final as regards the variation of the residue on 180 mesh, between 100% and 5%, in relation to the minimum power which should be expended up to any point, but it is considered to be a fair approximation.

The grinding by 1-in. diam. steel balls was efficient—they were quite heavy enough to break up the standard sand, during the early stages of the grinding, even with the small fall obtainable in the experimental mill. It was not found economical to use balls of a larger size.

When using the curve shown in Fig. 16 as a reference in connection with the grinding of rotary clinker, some allowance must be made, since most of the clinker fed to the mill will be larger than standard sand. Suppose the material put into the 18-in. mill, in the test previously described, had been in the shape of ¾-in. cubes, but of the same hardness as normal standard sand and it is required to compare the power required to reduce the material from ¾-in. size, to standard sand, with the power required to reduce the material from standard sand, to a residue of 5% on 180 mesh.

By Rittinger's law, the horsepower expended in grinding is proportional to the new surface produced. The accuracy of this law, within reasonable limits, is accepted by the writer.

Calculated to a specific gravity of 2.63 the surface area of the material in the three states, in sq. ft. per lb., is shown below:

	Surface in sq. ft. per lb.
¾-in. quartz cubes	0.60
Standard sand, taken as cubes of 0.0383-in. side	11.50
Standard sand, but ground to 5% residue on 180 mesh	650.00

In the last case the ground material was divided into several grades by sedimentation

(or settling in water). The width "d" of a large number of particles in each grade, was measured in one direction by a microscope, and the surface area of the average particle was estimated by treating it as a cube of side equal to "d."

The same procedure was followed when obtaining the surface area of the standard sand above.

It will be seen that on grinding ¾-in. cubes to a residue of 5% on 180 mesh, 649.4 sq. ft. of new surface are produced per lb. of sand, but when grinding standard sand to a residue of 5% on 180 mesh 638.5 sq. ft. of new surface will be produced. The horsepower required should be approximately proportional to the new surface produced in each case, so that—

$$\frac{\text{HP. to grind ¾ in. cubes to 5\% on 180 mesh}}{\text{HP. to grind standard sand to 5\% on 180 mesh}} = \frac{649.4}{638.5} = \frac{101.7}{100}$$

If, therefore, we add 1.7% to the power required for grinding any quantity of standard sand to a residue of 5% on 180 mesh, we may assume that the material ground was originally in the shape of ¾-in. cubes.

The reduction to standard sand size probably could not be efficiently done by 1-in. diam. steel balls in an 18-in. mill; it is desired, however, to bring out the small amount of power which is required for preliminary grinding.

Referring again to Fig. 16 the 1.7% of extra power has been added to the graph, so that the line *DE* represents, in correct proportion (within the limits previously referred to), the power required for grinding from ¾-in. cubes to 5% residue on 180 mesh.

Table Showing Grinding Mill Test Data

It is convenient at this stage to give a table showing the chief particulars which relate to eight selected tests on grinding mills, which have been made at various cement plants.

Table III gives the chief items in relation to each test, but it is not possible to include all the details, which will, therefore, be given later, together with the diagrams which relate to each plant.

It will be seen that the first three plants listed refer to the grinding of rotary clinker, and the remainder to the grinding of coal for use in rotary kilns.

The headings of the columns have already been referred to in detail, except those of columns 12 and 29. The figures in column 29 have been worked out in order that all plants may be compared on the same basis, as regards fineness of grinding, the standard residue being taken as 15% on 180 mesh. The correction necessary in each case is obtained from the reference curve, Fig. 16. Taking, for instance, the clinker grinding test at I. C. Johnson's works (line 1 on the table) the horsepower per ton per hour is given at 39 when grinding to a residue of 13% on 180 mesh, columns 28 and 25. From the reference curve the ratio of the powers in the two cases, would be—

$$\frac{\text{15\% residue}}{\text{13\% residue}} = \frac{74.0}{77.8}$$

hence the horsepower per ton ground per hour, referred to 15% on 180 mesh is

$$\frac{74.0}{77.8} \times 39 = 37.1$$

Test with Helipebs at Cameron Swan's Works

About three months after the test on the clinker grinding mill at Cameron Swan's works, the chief results of which are shown on line 2 of Table III, the flint stones were removed from the finishing mill, and helipebs substituted. At that time helipebs had been used to replace flint stones in several clinker grinding mills, and in some cases greatly improved results were reported.

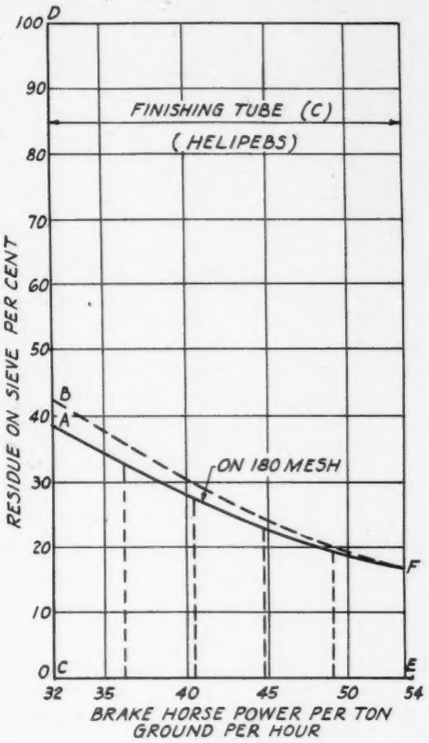


Fig. 17. Graph of grinding with helipebs

The test details, using helipebs, will be found on line 3 of the table.

Preliminary Mill. Compartment (*a*). The outlet diaphragm plate, marked *BC* on Fig. 12, was changed, the area through the slots being reduced from 750 sq. in. to 163 sq. in., the radius to the inner slot remaining as before (see Fig. 14). The effect was not marked. The charge of steel balls had been increased from 148 to 152 cwt.,* and the quantity of material retained in the compartment increased from 22.4 cwt.* to 24.2 cwt.* The ratio of the material volume, to the void volume, was 117%.

Preliminary Mill. Compartment (*b*). A similar change was made to the diaphragm plate *DE* in Fig. 12. The original charge of 72 cwt.* of flints had been replaced by 85 cwt.* of large new flints, the average weight of each being 8.8 oz.

The quantity of material retained in the compartment increased from 15 cwt.* to 18.5 cwt.,* and the ratio of the material volume to the void volume became 54.4%.

Finishing Mill. The flints were removed, and helipebs substituted. These weighed 1.3 oz. each and were of drawn wire of square cross section. The overall dimensions were: length, 1⅛ in.; external diameter, ¾ in.; internal diameter, ⅜ in. It will be seen from column 9, lines 2 and 3, that 156 cwt.* of flints were replaced by 169.5 cwt.* of helipebs. The helipebs being hollow, the quantity of material retained in the mill increased from 28.2 to 53.3 cwt.*

A cubic box of 1 ft. sides contained 173 lb. of helipebs. The solid steel would occupy $\frac{173}{490} = 0.353$ cu. ft., so that the voids were 64.7%.

In the mill, owing to the presence of the material, the helipebs did not pack so closely, since 1 cu. ft. of the charge volume contained only 149 lb. of helipebs.

It will be seen from columns 25 and 27 that the efficiency of the preliminary mill was somewhat less than before, since the residue on 180 mesh increased from 35 to 38.7%, although the output increased from 5.85 to 6.12 tons per hour. This is on the assumption that the clinker was equally hard to grind in the two cases.

The efficiency of the plant was slightly reduced by the use of helipebs, since the horsepower per ton ground per hour, referred to 15% on 180 mesh, was 51.8 in the case of flints, and 55.9 for helipebs.

Axial Sieve Test with Helipebs. An axial sieve test was made on the finishing mill only, the result being shown in Fig. 17. *BF* is the reference line, which starts (as usual) at 100% residue on 180 mesh, at the feed end of the preliminary mill.

The line *CA* on the graph gives the average residue on 180 mesh of the material leaving the preliminary mill, as obtained from the half-hourly samples taken throughout the tests. It may be compared with the line *GK* on Fig. 15.

The charge volume of helipebs (grinding bodies only) was 21.6%, and the value of the speed factor was 178. Experiments made later showed that this speed was too low for a partial charge of helipebs in a mill not provided with lifter bars on the lining plates.

Comparison of Clinker Grinding Tests

Referring to lines 1 and 2 of Table III, for mills nearly alike, the difference in efficiency was considerable, as will be seen by reference to columns 27 and 29. When grinding to the same degree of fineness the Cameron Swan plant required 40% more power than the I. C. Johnson plant.

*112 lb. based on English ton of 2240 lb.

— TABLE Nº III —

— DETAILS OF GRINDING PLANTS — SELECTED TESTS —

Location of Plant	Line Number	Material Ground	Type of Mill	Reference Letter	Dimensions Inside Lining: Average Diameter Inches	Dimensions Inside Lining: Length Inches	Dimensions Inside Lining: Volume Cubic Feet	Grinding Bodies: Description	Grinding Bodies: Total Weight Cwts.	Grinding Bodies: Detail of Single Grinding Unit: Mean dia. Inches	Grinding Bodies: Detail of Single Grinding Unit: Weight (average)	Grinding Bodies: Total Surface of Grinding Bodies Sq. Feet	Charge in Mill: Depth of Surface below Centre Line Inches	Charge in Mill: Weight of Material in Mill Cwts.	Charge in Mill: Volume Cubic Feet	Charge in Mill: Ratio % Charge Volume to Mill Volume	Charge in Mill: Ratio % Material Volume to Void Volume	Charge in Mill: Distance Cg Inches	Mill Speed: R.P.M. of Mill	Mill Speed: Speed Factor Sf	B.H.P. Required for Mill: B.H.P. for Mill	B.H.P. Factors: With Material Pm	B.H.P. Factors: Without Material Po	Mill Delivery: Mill delivery openings Normal free Sq. Inches	Mill Delivery: Material leaving Mill Residue on 180#	Summary: Moisture in fine Coal per cent	Summary: Plant Output Tons per Hour	Summary: B.H.P. per Ton Ground per Hour: As Ground	Summary: B.H.P. per Ton Ground per Hour: Referred to 15% on 180#
I.C. Johnson	I	Rotary Clinker	Tube	(a)	71·2	182·5	422	Steel Balls	280	4·0	9·6 lbs.	1382	6·0	64·6	166·4	39·2	202	16·5	23·1	169	146	1073	612	70	35·0	—	6·66	39·0	37·1
			de.	(b)	70·1	284·7	636	Flints	244	2·0	6·4 ozs	5940	2·5	69·0	288·7	45·4	86·0	16·3	21·9	181	114	1073	612	70	13·0				
Cameron Swan	II	do. do. (Flint Stone Test)	Tube	(a)	79·2	105·5	272	Steel Balls	146	3·0	4·1 lbs.	614	16·70	22·4	61·7	22·7	112	25·3	22·6	192	137	715	612	750	49·0				
			do.	(b)	76·1	88·4	233	Flints	72	2·0	6·4 ozs.	1760	8·66	15·0	62·4	35·4	52	21·0	22·6	194	57	715	612	750	35·0	—	5·65	50·5	51·8
			do.	(c)	65·9	240·6	473	do.	156	2·0	6·4 ozs.	3620	6·40	28·2	178	37·6	45	17·6	22·0	176	102	700	593	108	16·0				
Cameron Swan	III	Rotary Clinker (Helipeb Test)	Tube	(a)	75·7	105·5	278	Steel Balls	152	3·0	4·1 lbs	685	16·22	24·2	64·8	23·6	117·0	25·1	22·6	193	137·6	727	618	163	—				
			do.	(b)	76·3	88·4	284	Flints	85	2¼	8·8 ozs	1870	2·96	18·5	105·0	44·9	54·4	17·9	22·6	194	57·4	727	618	163	36·7	—	6·12	33·5	35·9
			do.	(c)	66·3	240·6	481	Helipebs	160·5	¾ × 1⅛	1·3 ozs.	5060	13·39	33·33	121·0	25·15	—	21·45	21·6	177	132·5	754	566	108	16·6				
Wouldham	IV	Kiln Coal	Kominor	(a)	66·5	54·0	115	Steel Balls	45	2¼	1·7 lbs	330	20·15	—	17·1	14·8	Not Taken	25·3	23·7	193	37·6	Not Taken	717		75·0				
			Tube	(b)	71·6	219·7	513	Flints	167	2·0	6·6 ozs	3970	7·0	—	192·5	37·6	do.	19·1	21·9	183	88·0	do.	793	91	24·5	2·2	4·32	40·6	38·6
			do.	(c)	71·0	55·2	127	Cylpebs	75	—	0·9 ozs	2050	15·82	—	28·6	22·5	do.	24·2	21·9	184	50·0	do.	793	103	13·0				
G & T. Earle Kiln III	V	do. do.	Kominor	(a)	65·7	49·7	98	Steel Balls	40	3¼	5·0 lbs.	204	18·87	—	15·2	15·5	Not Taken	24·6	25·5	201	34·4	Not Taken	730		68·0				
			Tube	(b)	60·0	169·0	310	Flints	101	1⅝	3·5 ozs.	3030	5·90	7·67	116·5	37·6	38·8	16·0	27·5	210	56·6	814	755	338	22·0	1·3	2·46	46·7	46·3
			do.	(c)	60·0	56·0	64	Helipebs etc.	38	—	1·2 ozs.	1120	5·30	3·26	24·6	36·6	62·0	15·7	27·5	212	21·8	814	755	338	16·4				
I.C. Johnson	VI	do. do.	Kominor	(a)	58·8	36·7	58	Steel Balls	24	3¾	7·8 lbs	105	15·8	1·90	10·2	17·6	116·0	21·2	25·5	189	17·5	800	742	21	72·0	0·4	2·53	20·3	20·
			Tube	(b)	46·5	193·5	166	Flints & Iron	124	1⅜	2¼ ozs.	3600	3⅞ ozs.	10·70	113·0	60·0	67·0	7·9	25·0	166	33·8	788	725	180	15·0				
G & T. Earle Kilns I & II	VII	do. do.	Kominor	(a)	51·1	37·5	44·4	Steel Balls	18	3⅝	5·8 lbs.	88	8·0	4·32	13·4	30·3	307	15·2	26·0	180	12·2	724	735		73·5				
			Tube	(b)	44·5	153·5	138	Flints	53	1¾	3·7 ozs	1850	2·0	—	61·2	44·3	Not Taken	10·5	24·4	160	20·7	Not Taken	656	252	32·0	1·0	1·59	27·8	30·5
			do.	(c)	44·5	31·0	28	Cylpebs	25·6	—	1·9 ozs	515	6·3	—	9·0	32·2	do.	12·9	24·4	162	11·4	do.	656	97	19·0				
Shoreham	VIII	do. do.	Tube	(a)	36·0	120·7	71	Steel Balls	65·5	1⅞	1·0 lb	735	0·80 (Flints)	7·60	36·2	51·0	114·0	7·5	34·2	200	27·3	672	620	172	54·0	2·8	1·85	37·8	41·1
			do	(b)	35·6	193·4	111·7	Cylpebs	106·5	—	3·0 ozs.	1855	5·7	5·04	41·3	37·0	75·3	9·6	34·2	201	42·7	672	620	85	18·6				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)

Table III. Compilation of grinding tests on coal and clinker

As previously mentioned the I. Johnson clinker was prepared from chalk and clay. The Cameron Swan clinker was made from the lime waste of an alkali works and clay. It was hard burned.

From the above tests it was realized that different plants could not be compared, as regards grinding efficiency, unless a hardness scale for rotary clinker was devised, and for this purpose the 18x18-in. experimental mill was eventually used.

The clinker from each works was ground in a small preliminary mill, and sifted so that grit passing a 20-mesh sieve, but retained on a 30-mesh sieve was obtained. A charge of 300 lb. of steel balls of 1-in. diam. was put into the mill, together with 42½ lb. of grit. The mill was rotated at a uniform speed, and the number of revolutions required to grind to a residue of 5% on 180 mesh was taken as a measure of the hardness of the clinker.

The various works of the Associated and the British Portland Cement Manufacturers now send up their clinker grinding mill results to the head office weekly, and the above method of estimating the hardness of the clinker made by each branch is in regular use. The efficiency of the various mills is thus properly compared.

It should be noted, however, that the above method does not allow for any initial disintegration of the clinker, which may be severe in some cases, as shown in Fig. 11.

The early tests made on clinker grinding plants showed (for reasons to be given later) that a series of experiments on a tube mill, installed in a laboratory, were desirable, and two members of the research staff were detailed for that purpose.

The research committee at that time however, were chiefly anxious to reduce the coal bill, hence the writer was mainly engaged in testing rotary kilns, and the coal drying and grinding plants used in connection with them. It is proposed therefore to give a selection of the test results on coal grinding mills, before proceeding to deal with the results obtained from the experimental mill.

(*To be continued*)

Comparison of Cement Industry in United States, Canada, and Great Britain

IN A RECENT ISSUE of *Cement and Cement Manufacture*, London, England, Hal Gutteridge, in the concluding article of a series, makes a comparison of the portland cement manufacturing processes in the three countries.

Regarding the raw materials, he states that the methods used vary considerably, since the hard materials mostly used in the United States and Canada require blasting and grinding, whereas the soft materials mostly used in Great Britain seldom require blasting and can be reduced in a wash mill.

The dry process, which was generally used until recent years, has gradually declined in favor of the wet process which at present is adopted in most plants. The dry process could not with advantage be applied in the United Kingdom because the raw materials (chalks, marls and clays) contain so much water that from this point of view alone the cost of drying would be too high and the dry process uneconomical.

The wet process on the other hand can be applied to all materials whether hard or soft, as the water content is of no consequence. The main reason for its increasing adoption is that it permits better control of the raw mix. This advantage is considered to outweigh the advantage of the dry process in reduced fuel consumption.

According to Mr. Gutteridge, the trend of development of the rotary kiln in the United States has been to keep the length of the kiln short and to maintain the temperature of the waste gases at a maximum for use with waste-heat boilers. In Canada and the United Kingdom the development has been towards the longer kiln as a matter of economy. As there are no dry process plants in the United Kingdom and as the price of current is not excessive, the development has been toward the long kiln where the heat in the escaping gases is so reduced that it is uneconomical to collect it for any useful purpose. The maximum length of the kiln with waste-heat boilers is usually about 175 ft., while the length of the kiln in the United Kingdom and Canada is usually between 250 and 400 ft.

With the soft raw materials on wet process in the United Kingdom there would appear to be no reason why the filter method widely used in the United States should not be equally successful, especially where the quarries are some distance from the plant and the percentage of water in the slurry has to be increased for pumping reasons.

Another method of increasing the thermal efficiency of the kiln is by the "spray" feed system. In this system the maximum surface of the slurry is exposed to the kiln gases and the greatest rate of heat exchange obtained. This is reflected in the low temperature of the waste gases, which in one of the plants in the United Kingdom is of the order of 200 deg. C.

In the pulverization of coal for firing the kiln the system most favored in the United States is the "central" system, while in the United Kingdom the "unit" system is in general use. With the latter the reduction of the coal is performed in one machine on the firing platform; no coal is stored in the pulverized state, as the kiln takes it direct from the machine. The power consumed is less and the space required is only a small portion of that required by the central system. The unit system is more responsive to fine and quick adjustments of feed, and this alone should recommend it for wider use in the United States.

The most important mechanical improvement of the kiln is the introduction of the combined kiln and cooler first installed in the United Kingdom in 1922. The integral unit has been generally adopted because of its obvious advantages over the separate kiln and cooler. Of lesser importance is the introduction in the United States of roller bearings for the kiln in place of the usual plain bearings. This permits of a smaller driving motor which can also be of a less expensive type because it is not called upon to overcome a high torque due to static friction in starting the kiln.

The most important recent advance in grinding is in the introduction of closed circuit grinding to the cement industry. In open circuit grinding the whole of the material, whatever its degree of fineness, is passed through every stage at a speed governed by the time it takes to reduce the largest particles to the maximum final size required. The result is that much material is unnecessarily ground to a greater fineness than is required, and the presence of the ultra-fine material reduces the efficiency of the grinding media, absorbs unnecessary power and limits the rate of feed. With closed circuit grinding all material below a predetermined fineness is withdrawn from the process at one or more points, so that the production of unnecessary ultra-fine particles is avoided. The result is a reduction of power required for the same quantity ground, or an increased output for the same expenditure of power.

Up to the present, closed-circuit grinding on both wet and dry processes has been applied mostly in the United States to raw material reduction, and for this purpose it has in the United Kingdom a very restricted field because the majority of the raw materials, being soft, do not require grinding.

New Process Using Lime

A NEW method for the production of bleaching powder, representing a departure from previous methods, has been developed and put into commercial operation at Brescia, Italy, according to a recent article in *Chemical and Metallurgical Engineering*. The reaction between hydrated lime and chlorine takes place through the medium of an organic liquid such as carbon tetrachloride, which is capable of dissolving chlorine but is inert toward lime and chloride of lime. Thus the finely divided lime particles have their entire surfaces exposed to the action of chlorine.

As the inert liquid readily absorbs the heat of reaction, it uniformly distributes this heat over the lime particles or over the bleaching powder particles in progress of building; therefore, during the reaction they are constantly kept at the same temperature as the liquid. The carbon tetrachloride accordingly acts as a temperature regulator, and also serves as a means of crystallization of the bleaching power.

The hydrated form of the product contains 38-39% of available chlorine and has a water content of 6%.

Opportunities for Using Indicating and Recording Control Instruments in the Rock Products Industries

Part VII—Instrumentation in the Petroleum Industry

By James R. Withrow

Chairman, the Chemical Engineering Department, Ohio State University

THE ADVANTAGE to industry of instrumentation has been brought out in the previous articles by cases from the automobile and other industries. These cases showed what instrumentation has done in this most progressive industrial development of all. The direct and indirect advantages to the rock products industries have been pointed out and it has been shown how instrumentation has made possible this astounding growth, and how industry as a whole has actually paid for the perfecting of instrumentation for practically every purpose. This development now exists ready at hand for the use of the rock products industries.

Instrumentation Forced by Refining Developments

Of the present enormous gasoline production only about one-half could possibly be produced by the old methods with little instrumentation. This is the "straight run" gas and possibly the "natural gasoline." It is probable that not a single barrel is actually produced without instrumentation today. Formerly the oil industry was more crude than the rock products industries ever dared to be. Today there is no industry so greedy for temperature measuring, indicating, recording and control devices as the petroleum industry.

Editors' Note

***THIS SERIES** of articles is designed to interest rock products operators in the possibilities of instrumental control of operations, still almost entirely controlled by rule-of-thumb. Other industries with similar control problems have far outdistanced the rock products industry.*

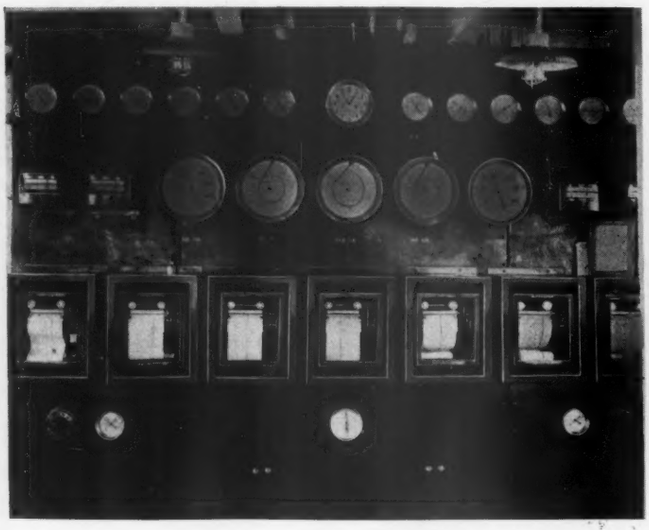
These article are not intended to be complete or detailed descriptions of processing. They present only a sketchy outline of such processing — but enough, it is hoped, so that the wide-awake rock products operator will see parallels or at least similarities to his own operations.—The Editors.

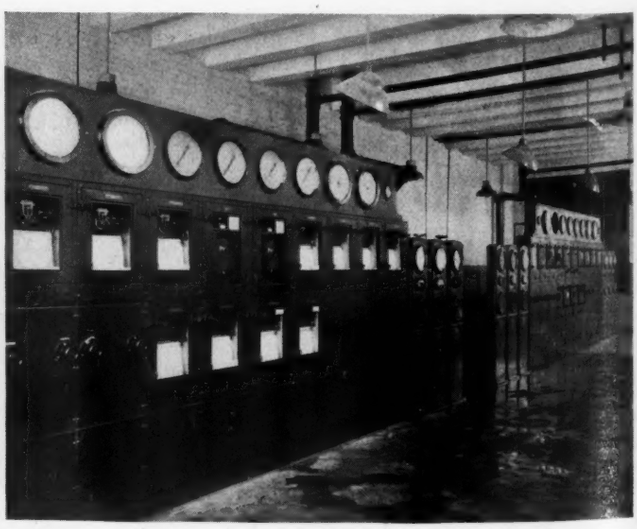
Even natural gasoline is produced through the use of proper indicating instruments. Straight run gasoline today is more and more being produced in continuous pipe stills into which the crude oil is continually pumped and from which there flows a continual stream of gasoline and residual for refining into kerosene and lubricants or bitumen (asphalt). Such a continuous device cannot be controlled except by continuous measurement—instrumentation.

However, in the case of about one-third the daily production there is no possibility of operating without the most highly developed instrumentation. This applies to the manufacture of cracked or pressure gasoline, the amount of which is continually increasing. Those who remember the first two processes (Rittman and Burton) which paved the way for this development will remember the risk of heating petroleum to such high temperatures as 750 to 1200 deg. F. and to pressures up to 750 lb. per sq. in. without instruments and with expensive technical men manually controlling the pressure. Any carelessness meant excessive pressures, with possible explosion and loss of life. However, the demand for gasoline never let up and the industry which at first scorned engineering and instrumentation rapidly became the greatest developer of instrumentation. Self protection compelled intelligent instrumental control. Fig. 27 (courtesy Brown Instrument Co.) shows a modern instrument board at a Barnsdall, Okla., refinery.

Importance of Instrumentation to the Oil Industry

Drilling tools. The oil industry starts with drilling for crude oil. In the three general types of drilling, cable, rotary drill





Figs. 27 and 28. Typical instrument board layouts in gasoline refineries

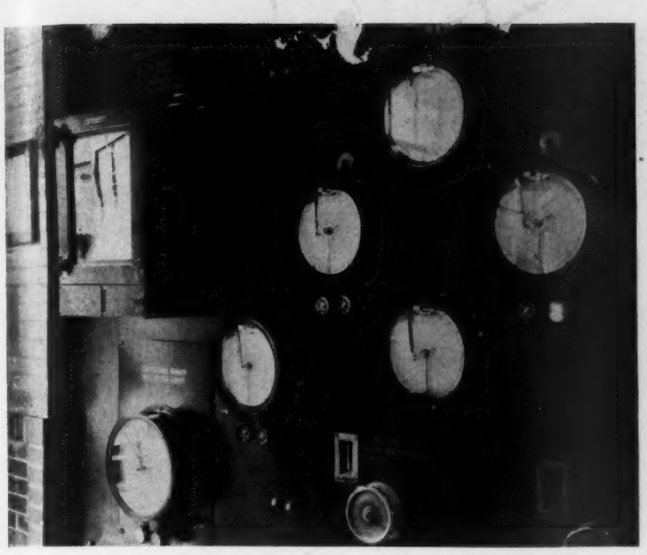


Fig. 29. Tower control board for both flow and temperature recording and control

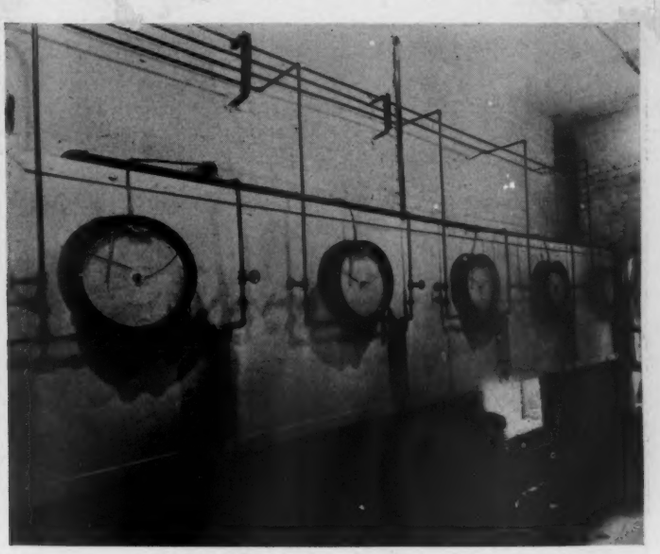


Fig. 30. Automatic temperature control instruments on bubble towers

and core drill, proper conditioning of the bit is of primary importance. Improper tool dressing is costly both from the standpoint of deterioration and time consumption, and it is estimated that 25% of the total drilling time is consumed in replacement of dull bits. This can be reduced to a minimum if the life of the bit is prolonged by proper tempering.

The molten-lead bath is now used for hardening bits and other small parts. The hardening temperatures are between 1380 and 1500 deg. F. and the temperature in the carburizing pot frequently goes as high as 1750 deg. F. for carburizing rock-bit cones. All guesswork is eliminated by the use of indicating pyrometers where the temperature of the bath is shown at all times.

Crude oil transportation through pipe lines. The crude oil is transported from oil field to refineries in different parts of the country by pipe lines. Oil is forced through the line by means of pumps operated by steam, electricity or internal combustion engines. Diesel engines are extensively used. For their operation a correct knowledge of the exhaust gas temperature is necessary in order to check up the operating efficiency and anticipate a possible breakdown. On an evenly operated two-cycle Diesel engine at no load the exhaust gas temperatures are approximately 125 to 135 deg. F.; at 25% overload, or full capacity, about 600 deg. F. On a four-cycle engine, this range is usually 250 deg. F. at no load and 775 to 800 deg. F. at 25% overload, or full capacity.

Fig. 31 (courtesy Brown Instrument Co.) shows such use of pyrometers for measuring the temperature of the exhaust gases. With the pyrometer any adverse operating condition, such as unbalancing, which may lead to serious consequences, can be detected. Besides, with the use of the instrument, centralized control is possible. A mere turn of the wrist will give the temperature of any one cylinder, and it is not necessary for the operator to climb over the engine in order to read temperatures. Pyrometers also indicate any abnormal condition demanding prompt investigation.

Instrumentation minimizes loss by evaporation. To begin with, the crude petroleum must be stored at refineries in steel tanks. Distillates, gasolines and other products are stored likewise. An important consideration in tank storage is to prevent loss by evaporation. The extent of the loss is determined by the quality of the crude oil or the specific gravity of the fractions and the temperature during storage. The lighter the crude oil and the higher the temperature, the greater is the percentage of loss by evaporation, but by correct control of temperature this loss can be minimized.

In the storage of casing head gasoline, it is not desirable to open the tank. Permanent thermocouples can be installed, therefore, and automatic recording of temperatures of all storage tanks is made at a single station by multiple point recording instruments.

Fig. 31. Pyrometers are used for measuring temperature of exhaust gases

Instrumentation prevents loss in measurement of volume. In the storage of gasoline, temperature is a factor in the calculation of volume. The standard temperature for all sales and transfers is 60 deg. F. After the contents of the tank are calculated, a plus or minus correction must be made for expansion or contraction if the temperature is either substantially above or below 60 deg. F. Thus it is of prime importance to know the exact temperature in determining the volume bought or sold. In the case of gasoline, a variation of 15 deg. may cause an error as high as 1%. In a 50,000 bbl. tank of gasoline a variation of 3 deg. may make a difference of 100 bbl. in volume.

Instrumentation gives performance of each unit. One of the prime requisites in the control of refining operations is an accurate knowledge of the performance of each unit of equipment. This can only be had by automatic measurement or instrumentation. The equipment used in oil refining has undergone rapid changes during recent years. Crude oil, the base of all refined products, is separated into gasoline, kerosene, gas-oil, lubricating oils, wax, asphalt, fuel-oil and coke by a process of distillation. This process requires the application of heat and an accurate control of the heat is essential in order to obtain results. Temperature measuring instruments of various types are extensively used for this purpose.

Potentiometer recorders used to maintain uniform crude distillation indicate the oil temperature in the still and also indicate the vapor temperatures. The width of the band on the record gives the difference between these temperatures. This tells the operator just how the work is going and tells the management whether the operation was normal. Under the old gravity cut system the executive never knew anything about the

Fig. 32. Typical instrument board in modern refinery

firing irregularities, boil-overs or banked fires of the night before.

Fire box or furnace control. Accurate control of temperature during distillation of the crude petroleum is just as important as it is during the distillation of the finished products. In each process accurate control of the heating conditions is essential in order to obtain the maximum yields. Variations of a few degrees from the optimum temperature conditions may easily result in failure.

Controlled combustion conditions within the fire box, and above all a uniform and constant temperature of the oil leaving the outlet-coil from the still, is necessary to stabilize the operation of the bubble tower (fractional distilling column) and to insure products of a uniform character. In order to obtain these results many variables have to be taken into consideration. The most important are: the control of fuel to the burners, the air-fuel ratio to secure efficient combustion, the proper distribution of the resulting heat to the various surfaces to be heated, and the rate of feed of the crude oil to the tubes. The temperature of the crude oil supply may be held uniform and constant by a system of heat interchangers so that the variations due to weather conditions are greatly minimized.

Fig. 32 (courtesy Foxboro Instrument Co.) showing Cities Service Refineries Co., Braintree, Mass., is typical of the instrument board in a modern refinery.

Automatic Control of Bubble Towers

It is necessary to separate the hydrocarbon constituents of petroleum into such fractions that a given product such as gasoline will be clean cut, that is, will not be too volatile, or have a high evaporation loss in summer and will have a good pick-up in winter. Also, that it will stop short at the upper end of its boiling point curve, and not have kerosene in it or burn incompletely. This is accomplished by fractional distillation in "bubble towers" which are intricate mechanical devices in which only liquid and vapors are in motion. Fig. 29 (courtesy Foxboro Instrument Co.) shows a tower control board for both flow and temperature recording and control.

Automatic control of the bubble tower can be accomplished by potentiometer controller arrangement which can control the temperature within a total variation of 6 deg. F. The reflux tower temperatures can also be controlled successfully in a similar way by one of two thermocouples at the top of each tower connected to and controlled by a proportional step controller through a motor valve mechanism. The other thermocouple is direct connected and records the temperature on a potentiometer recorder.

Fig. 30 (courtesy Foxboro Instrument Co.) shows the use of automatic temperature control instruments to control the reflux on bubble towers. Each of the five temperature controllers on the instrument-board is used to control one reflux line. The air pressure in the air line (at the right of the instrument) is indicated by the gage below and at the right of the instrument. The line at the left of the instrument is an air line used to lead air away from the instruments actuating the diaphragm valves which in turn control the amount of reflux returning to the bubble tower.

Paraffin Wax Refining

The manufacture of paraffin wax involves both the high temperatures of distillation and the low temperatures of refrigeration. Wax production is usually considered as a part of the manufacture of lubricating oils. The wax distillate cut from the crude oil distillation contains the paraffin wax of commerce dissolved in light, intermediate and heavy lubricants. The separation of the wax and its subsequent refining to finish paraffin involves two stages after distillation: (1) the chilling and pressing of wax distillate; and (2) the sweating of paraffin wax.

The chilling and pressing of the wax distillate makes the refrigerating plant one of the important units of the oil refinery. Temperature measuring instruments, both recording and indicating and controlling, as well as thermometers, have been widely used.

Ammonia compressors. A thermometer in the discharge line of ammonia compressors used for wax separation affords an accurate means for determining the mechanical condition of the compressor. If the thermometer in the discharge line registers a temperature much in excess of that which would normally exist in case the suction temperature had been carried within 10 deg. of the saturation point, it is reasonable to conclude that the ammonia gas on the suction stroke is receiving heat from some artificial source, such as leaky safety leads, discharge valves, or pistons. This excess will be shown by excessive discharge temperatures and periodical observation of the discharge temperatures gives the best information on the condition of the compressor. Ammonia condenser efficiency can also be measured by proper temperature indicating devices.

Wax sweater. The chief object of wax sweating is to obtain a maximum percentage of paraffin scale of the desired melting point, with a minimum oil content. This is to be accomplished in the shortest time practicable within a minimum expenditure of power and labor.

Usually the temperature of the wax sweating room is controlled manually by operating the steam line and cooling water line valves. An increase in temperature will: (1) melt out or waste some of the scale (which is the desired product); (2) close up the cell to such an extent that the final product will contain a relatively high percentage of oil; and (3) represent a needless expenditure of steam. A decrease in temperature will: (1) retard the process; (2) chill the outer surfaces of the crude slack wax in the pan; and (3) arrest the flow of oil from the core of the slack wax cake and upset the balance.

In the above operation, because of human limitations in control of the whole process, and because of the necessity of obtaining a uniform standard product, manual control is giving way to automatic control which regulates the temperature automatically in accordance with a predetermined time and temperature schedule.

Fuller's Earth Reclaiming

In the manufacture of lubricating oils they

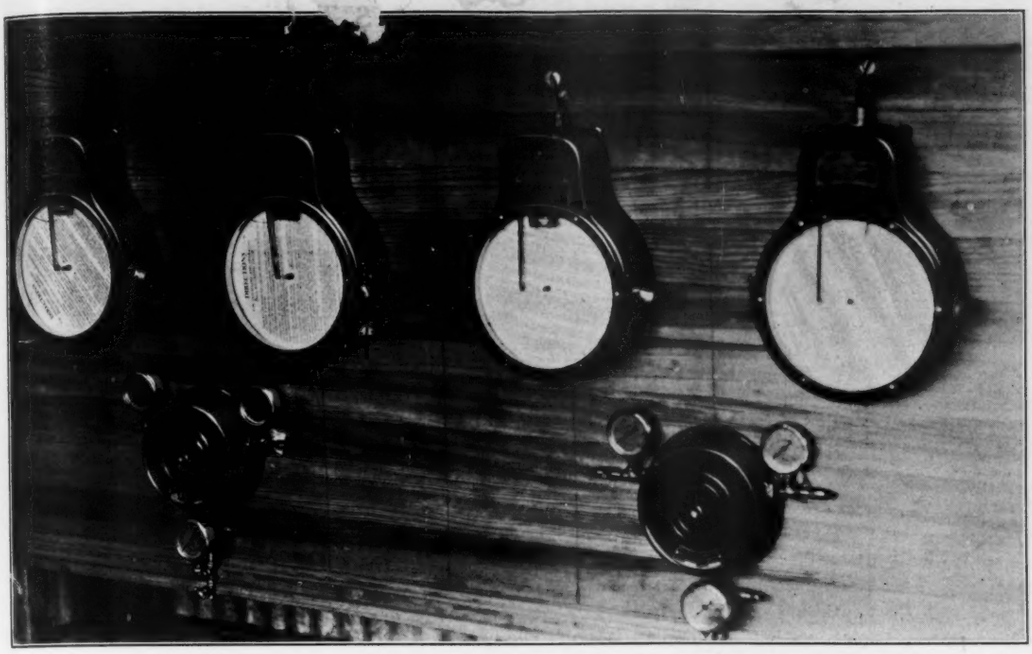


Fig. 33. Instrument board under construction in natural-gas gasoline plant

must be filtered to get rid of excess colors and impurities. Fuller's earth is extensively used for this and it is necessary to dry the new earth before filtration to secure its greatest absorption power, and to burn or to calcine the tarry matter in the clay after filtration.

In both processes, the maintenance of proper temperature is necessary. The temperature must be high enough to burn out the tarry matter and drive off the undesirable constituents, but not so high as to disintegrate or glaze the earth. Vertical ovens and rotary kilns are generally used for this purpose.

In the vertical oven the earth is fed down in intimate contact with the hot gases from the burners underneath, as in the case of the Herreshoff furnace. In the rotary kiln, burners are located at the front end and the hot gases passing through come in contact with the earth and leave at the rear of the kiln where they meet the incoming charge.

Multiple-point temperature recorders are used for recording the thermocouple temperature of different sections of a vertical multiple hearth furnace for the reclaiming of Fuller's earth and it is claimed that with this set up it is possible to reclaim earth from 30 to 35 times.

Natural-Gas Gasoline

Natural gas often contains gasoline vapor which is reclaimable and the resulting "casing head" gasoline as it is generally termed, has been used to a large extent in the blending of other gasolines. The volume now made is 12-15% of the total gasoline produced.

Natural gas is termed either wet gas or dry gas according to its gasoline vapor content. Wet gas contains as high as 1 gal. gasoline per 1000 cu. ft. of gas, while dry gas contains vapor in smaller proportions, as low as 0.1 gal. per 1000 cu. ft. of gas. Two general processes are used in the condensation of natural gasoline: (1) the compression process for wet gas; and (2) the absorption process for dry gas.

The use of industrial and recording thermometers and pressure gages is a long established fact in the natural gasoline industry. The indicating type is used more in the nature of a guide and for testing, while the recording instruments give a continuous record of temperatures and pressures whether controlled automatically or manually.

The natural gasoline industry has progressed considerably beyond the stage where the engineers and operators must be shown the benefits of automatic regulation. Such advantages are an accepted fact so that it is now only a matter of the proper selection of regulating equipment.

The growing use of automatic control represents a tremendous step forward in the development of the ideal gasoline plant. Indicating thermometers and pressure gages tell what the condition is, and the recording gages tell what the condition was, but the efficient and dependable regulator tells what the conditions will be, once the instrument is set for the desired temperature or pressure factor.

Application of temperature regulators to the absorption plant controls the temperature of distillation and fractionation,

Fig. 34. Industrial thermometers used on compressor discharge lines in natural-gas gasoline plant

with the prevention of overheating of the absorbent oil and ensures the production of gasoline of proper end point and color.

Fig. 34 (courtesy Taylor Instrument Companies) shows the use of industrial thermometers on compressor discharge lines in a natural-gas gasoline plant. Fig. 33 (courtesy Taylor Instrument Companies) shows the instrument board under construction in a natural-gas gasoline plant, showing recording thermometers, recording pressure gages and pressure regulators.

Pressure Distillation or Cracking

The cracking process previously referred to consists in converting a heavier petroleum product of higher boiling point into more volatile fractions. This is also referred to as "pressure distillation."

Cracking stills of many types are now in operation, and developments are still going on with radical changes and improvements reported frequently. But in one respect, at least, the cracking process has reached a firm basis. Whatever may be the type of still or the process used, efficient operation depends, to a great extent, on instrumentation. Because of the very high temperatures used, and because fluctuations in temperature greatly affect the yield, it is very important that the selected temperatures be maintained with minimum variations in order to obtain maximum yield and best results.

An increase in temperature will result in the formation of fixed gases, resulting in direct loss, while a drop in temperature increases the amount of recycle material and affects the capacity of the still. Deviations for even a short period of time are detrimental. Proper temperature control enhances the yield, reduces carbon formation, and eliminates the wear and tear on apparatus caused by fluctuations of firebox conditions under hand firing.

Proper instrumentation gives proper temperature and heat control in the cracking operation. It stabilizes the reaction temperature and in turn the rate of reaction and distillation to such an extent that accurate cuts, constant output, and maximum yield are obtained. The fluctuations due to variations in reflux and other distributing factors are eliminated and minimum rerunning is ensured, all of which are other ways of saying that operating costs are reduced.

Fig. 28 (courtesy of Leeds and Northrup Co.) shows a view of an instrument board and typical layout of the pressure gasoline portion of an oil refinery. This shows the temperature recorders, as well as other temperature control devices. The instruments not only indicate and record the temperatures but also control the amount of fluid flowing in the various units.

Instrumentation and Precision Control

As already shown, instrumentation results in precision operation and control. Precision control does the following:

1. Improves the quality of the finished product to meet more exact specifications.
2. Permits the reproduction of any product so that it is uniform.
3. Increases the yield per unit of crude oil.
4. Decreases cost through the elimination of wasteful and unnecessary operations.

The following precision controls are the most essential:

1. Automatic fire control.
2. Thermostatic reflux tower control.
3. Thermopile control in the tube stills.
4. Remote control of temperature.
5. Recording and indicating thermometers.
6. Recording and indicating pyrometers.
7. Cycle temperature controllers, etc.

Development and control laboratories were necessary to run tests, to insure precision control by instrumentation at the optimum point and to inspect the finished product before shipping. At the Bayonne, N. J., plant of the Tide Water Oil Co., for instance, an average of 85,000 individual tests were made per month by the control laboratory.

Thus, instrumentation in the oil industry has brought about precision control and as a result of precision control better and more uniform products are produced and a better efficiency and economy is maintained which could not be realized otherwise.

(To be continued)

Nevada Nonmetallics

A VAST store of nonmetallic minerals lies in Clark county, Nev., awaiting development when Hoover dam power becomes available, according to A. M. Smith, state bureau of mines.

He stated that among other nonmetallic deposits in Nevada that he has investigated, is a deposit of green slate, about 55 mi. northwest of Las Vegas. He found that a bedded deposit from 100 to 300 ft. wide exists there.

"Another deposit of structural material—a soapstone lying 7 mi. north of Nipton, is of peculiar interest," he said. "This is also a large bedded deposit, very old geologically. It is dark gray in color, and might produce dimension soapstone of excellent quality. The location is rather remote, but not too far from the railroad to be prohibitive.

"Gypsum deposits in Clark county have been frequently described by geologists Three very large deposits, though, have not received public notice, namely, the Mateucci group adjoining and lying immediately southwest of the Blue Diamond mine; the Anderson gypsum, 7 mi. west of the Muddy river crossing in Virgin river valley; and the McDonald Mines Co., gypsum deposit, 7 mi. southwest of St. Thomas."—*Tonopah* (Nev.) *Times.*

A. S. T. M. Committee on Road Materials Recommends Standards

THE Committee on Road and Paving Materials of the American Society for Testing Materials which met in Cleveland, March 9, as part of the A. S. T. M. spring group meetings of committees there, March 7 to 11, recommended adoption as a tentative standard of the method of chemical analysis of calcium chloride, published as information in an appendix to the 1931 report of the committee. It was also recommended that the tentative revisions of the five definitions for bituminous road materials, adopted at the last meeting, be accepted as standard. Work during the past year of the subcommittee on extraction of bituminous aggregates was considered to be of sufficient importance to be incorporated as an appendix to the 1932 annual report of the committee. It was also decided to recommend a revision of the tentative method of test for consistency of portland-cement concrete (D 138-26 T).

Considers Marketing Montana Phosphate

JAPAN and China, when they get their differences adjusted, may furnish a market for some of Montana's phosphate deposits, in the opinion of officials of the Northern Pacific railway. The Northern Pacific has a large phosphate deposit at Elliston, it was stated recently, by P. E. Thien, consulting engineer, who has been investigating the company's holdings in that district.

If the deposit comes up to expectations the railway expects to handle it as the iron deposits on the company ground in Minnesota have been handled.

China and Japan will offer an ideal market, in the opinion of the Northern Pacific engineer.

"The Northern Pacific has no intention of building a plant to treat the phosphate," Mr. Thien said. "Present phosphate producing companies have an ample supply of rock. Likewise, the American market is well covered. No effort up to date, it is understood, has been made to capture the Asiatic phosphate market."—*Butte* (Mont.) *Standard.*

Agricultural Limestone Promotion

THE CORRESPONDENCE of the National Agricultural Limestone Products Association is conducted on a 4-pp. letter circular (illustration on page opposite). The color scheme is pale green paper with darker green and black for borders and type. The whole is attractive and illustrates one fairly effective way to put across a promotional idea.

E. J. BURKE, Vice-President — FRED O. HARPOOTLIAN, President — W. H. MARGRAF, Sec.-Treasurer

The National Agricultural Limestone Products Association

INCORPORATED

COLUMBUS, OHIO

December 24, 1931.

Mr. Nathan C. Rockwood, President-Editor
Rock Products,
542 South Dearborn St.,
Chicago, Ill.

Dear Sir:-

In accordance with the promise in my letter of November 30, I am enclosing an article for your annual review issue to be published January 9, 1932.

Very truly yours,

Secretary - Treasurer.

W. H. Margraf/EV

LIME THE LIBERATOR

1. Corrects acidity. Crops grow best in neutral or only slightly acid soils.
2. Supplies plant foods. Calcium and magnesium are necessary plant foods.
3. Improves tilth. Makes heavy soils—binds sandy soils.
4. Energizes humus. Promotes the decay of organic matter to form humus.
5. Promotes nitrification. Encourages growth both of the bacteria which make available the nitrogen in the humus and the nitrogen in the air.
6. Increases efficiency of fertilizers. Makes both fertilizers and manures more effective.
7. Counteracts soil poisons. Renders the toxic compound of aluminum insoluble.

Object of Association

To establish standards of production and quality; to promote, urge and increase the use of agricultural liming material.

Don't Let Them ROB Your Soil

TWO elements are constantly at work, robbing all crop soils of lime. One of these is leaching, which can easily remove the equivalent of a third of a ton of pulverized limestone per acre in a single year. The other is the growing crops themselves. All plants "eat" lime. The average crop of alfalfa uses up about 175 pounds of pulverized limestone per acre. When the surplus lime is gone, acidity starts—production drops and profits disappear.

You might as well allow someone to cart away the top soil of your farms, as to allow leaching and cropping to remove the free lime without replacement. There is just one protection against these soil robbers. Play safe. Lime your soil at least once in every crop rotation. It is the cheapest crop insurance you can get.

How to Apply Lime

For immediate results, lime is best applied on plowed ground before discing and harrowing. On farms where liming is practiced every four to six years, it makes little difference when the material is applied. For best results lime must be distributed evenly. This is difficult to accomplish by hand. If there is not enough liming to warrant the investment in a standard lime spreader, other mechanical devices may be used. The fertilizer compartment of a grain drill will handle lime. There are practical endgate spreaders which attach to the rear of a wagon box. Some of the better makes of manure spreaders can now also be supplied with an excellent liming attachment.

This Association will be glad to help any farmer secure a correct lime analysis of his soil. Its members will also be pleased to figure as to the best and most economical forms of lime to apply. Write the Secretary for names of the nearest Association members. Please feel free to ask any questions you wish regarding the use of agricultural liming materials.

How to Tell Acid Soils

IF alsfalfa and clover do not take hold well, you can be sure that the soil is sour. If such common weeds as sheep sorrel, paint brush, daisy, horsetail rush and goose grass thrive, acidity may be suspected. Take a representative sample of the soil, mix thoroughly and add enough water to make a stiff mud. Roll some of this into a ball. Break open and press a strip of blue Litmus paper between the halves. Allow to stand for ten minutes and then examine the paper. If it has turned pink or red, the soil is acid. Blue Litmus paper can be purchased in any drug store.

Litmus Paper affords a quick and cheap test for acidity. But it does not indicate the amount of lime required to remedy the condition. If you want to know how much lime to apply per acre, consult your county agent or your State Experiment Station. They will gladly make the necessary tests for lime requirement.

LIME THE LIBERATOR

The National Agricultural Limestone Products Association
Secretary's Office Columbian Bldg. COLUMBUS, OHIO

Seven Points of PROFIT

LIME THE LIBERATOR

FROM the agricultural standpoint, the word "lime" means "an acid-neutralizing material containing calcium and magnesium oxides." There are many sources for these substances, ranging from marl and chalk to clam shells and industrial wastes. In most localities, however, the principal source is the well known rock commonly called limestone, which is quarried in large quantities for agricultural purposes.

Agricultural Lime

LIME is commonly applied to crop soils in one of three different forms: Ground Limestone of varying degrees of fineness. Burned Lime or Quick Lime in powdered form. Hydrated Lime or Slaked Lime in powdered form.

The powdered Burned Lime contains the greatest amount of available oxides per ton and gives the quickest results. The greatest drawback in connection with its use, is the extremely irritating nature of the dust clouds raised when applying it. Burned Lime is highly caustic and the dust is hard on man and beast alike.

Hydrated Lime is Burned Lime which has been slaked by the addition of the proper amount of water. Hydrated Lime is not so concentrated as Burned Lime since 74 pounds of it contain only as much of the available lime oxides as 56 pounds of Burned Lime. It is not caustic however, and thus much pleasanter to apply. Hydrated Lime is also very finely powdered—much finer than can be secured by grinding unburned limestone. It therefore gets quicker results.

Ground limestone is the lowest priced form of agricultural lime. It is not so finely powdered as Burned and Hydrated Lime and therefore does not yield full results as rapidly. Ground Limestone is rated according to its fineness. The finer it is ground, the more it costs to produce. All members of The National Agricultural Limestone Products Association guarantee that a certain grade of their product will be up to certain standards of fineness. For example, one grade may be guaranteed as passing 100% through a 10 mesh screen, 85% through a 50 mesh screen and 65% through a 100 mesh screen, while another may be guaranteed as 90%, 60% and 45% through the same screens. The finer particles naturally dissolve first. The coarser particles, dissolving more slowly, form a neutralizing reserve the effect of which lasts for a greater number of years.

Why Use Lime?

THE only logical reason why a farmer should apply anything to his soil is that it will enable him to grow crops of a more valuable nature—or bigger crops per acre at a lower cost. Practically all crop soils contain calcium—and calcium is the principal material in lime. The question therefore is: Why apply lime?

The answer is very simple. Apply lime because by adding it to your soil you will be able to grow crops of a more valuable nature—and because you will be able to increase the production per acre. Lime also pays in another way—by making tillage easier. The nature of these various results is sketched in the following paragraphs.

★ *LIME Corrects Acidity.* The processes of nature are continually adding acids to the soil. The very rain that falls on the land contains acid-producing substances such as carbon dioxide and sulphur. Decaying organic matter produces acids. Many chemical sprays and fertilizers leave acid residues. The process of nitrification through the action of bacteria produces nitric acid. Practically all crops grow best in neutral or only slightly acid soils. As acidity rises, crop production falls off. This result is inevitable unless corrective measures are applied. Lime is the perfect corrective.

★ *LIME Supplies Plant Foods.* All plants require both calcium and magnesium. "Agricultural Lime" is just another name for a mixture of calcium and magnesium. Every crop depletes the lime content of the soil to some degree. If there is not enough lime available, the plants starve.

★ *LIME Improves Tilth.* Through a peculiar chemical effect known as "flocculation," lime has the faculty of making heavy clay and silt soils more porous and granular. If properly limed, these soils no longer puddle when wet or cake when dry. They cease to be sticky and become loose and friable. This loosening action permits better root penetration, better air circulation and better drainage. It also makes the soil easier to till. Plowing, discing, harrowing, seeding and cultivating can all be done quicker and easier. On the other hand, in very light soils such as sandy and gravelly loams, lime has a tendency to slightly cement the loose grains, rendering the soil closer in texture so that it is less readily dried out in seasons of drought.

★ *LIME Energizes Humus.* One of the most valuable elements in crop soils is the humus which is supplied through the addition of green and stable manures and crop residues (roots, stubble, etc.). However these substances are valueless until they have first decayed and passed through a series of processes which are the result of a long chain of bacterial action. First come the bacteria of decay. Next the ammonifying bacteria which liberate ammonia. Third comes a group of bacteria which convert the ammonia into nitrous acid. Finally comes a fourth group of bacteria which are termed the *Nitrobacter*. These change the nitrous acid into nitric acid which combines with calcium and other basic elements to form nitrates. Nitrates are soluble nitrogen salts which are readily available as plant food. Lime creates the conditions which are friendly to all of these bacteria. It energizes them into the actions by which the inert organic compounds are changed to valuable plant foods.

★ *LIME Promotes Nitrification.* In addition to the bacteria which make available the nitrogen in the humus, there are two other groups of bacteria which capture the free nitrogen of the air so it can be used as plant food. The air is practically four-fifths free nitrogen. There is present in practically all fertile soils a group of bacteria termed *Azotobacter*, which have the power of capturing the air nitrogen and converting it into plant food. And lastly, there is that group of bacteria associated with the legumes (clover, alfalfa, peas, etc.). These reside in nodules on the roots of the legumes and are able to appropriate the free nitrogen of the air and pass it on to the tissues of their host. Neither of these groups of bacteria can function efficiently in acid soil. Lime creates the conditions under which they thrive.

★ *LIME Increases the Efficiency of Fertilizers.* Thirty years of continuous lime tests by the Ohio Experiment Station show the following remarkable figures for the last two five year crop rotations. Land which had received $16.26 worth of fertilizer per acre, produced crop values of $69.24. Land which had received the same treatment plus $10.00 additional spent for liming, produced crop values of $123.05. In other words, $10.00 spent for liming added $53.81 to the profits returned by the fertilizer. Here is a profit return of 538%. All fertilizers and manures are more effective in lime rich soils.

★ *LIME Counteracts Soil Poisons.* Certain compounds of aluminum which are poisonous to crop plants may become plant soluble in very acid soils. Lime ties up these compounds, making them harmless.

Acid Soil a Foe to Profits

EVERY rain that falls, every plant that grows, every bit of organic matter that decays—all are adding acid to the soil. So long as there is a surplus of lime present this acid is neutralized. When the lime is used up the soil rapidly develops more acid year by year—crop production steadily declines.

Some crops, such as alfalfa and sweet clover, simply cannot be raised at all on ground that is more than slightly acid. Yet as nearly every farmer knows, these crops are doubly valuable. First, because of their high value as feeds. Second, because they help store nitrogen in the soil for succeeding crops to feed upon.

It is true that on soil which is otherwise fertile, many grain and grass crops will grow fairly well altho considerable acid is present. Yet even such crops will produce enough more to pay their share of the cost of liming. It pays to lime any soil which is more than slightly acid. The best proof of this fact is contained in the following paragraph.

Experiments in Eleven States

THE State Experiment Stations of Wisconsin, New York, Pennsylvania, Indiana, New Jersey, Michigan, Rhode Island, Delaware, Virginia, Kentucky and North Carolina are among those which have made a long and conclusive series of tests on the effects of liming. Sixteen different field crops were used in these experiments and the conditions were of the most widely varying kinds. The grain crops grown were Barley, Corn, Wheat, Rye, Oats. The hay crops were Alfalfa, Clover, Soy Beans, Clover and Timothy, Rape, Oats and Peas, Barley, Oats. The miscellaneous crops were Mangel Beets, Cotton, Peanuts. On the basis of one lime application in each 4-year rotation, every dollar spent in liming returned added crop values of $3.02. Corn, Wheat and Oats all will stand fairly strong acidity, yet Corn returned $2.06, Wheat $2.12 and Oats $1.82. Even Rye, which will withstand more acid than any other grain, returned $1.63.

After thirty years of tests by the Ohio Experiment Station, in which lime was used on fertilized land, with a five year rotation, it was shown that each dollar spent in liming was returning $6.38 in added crop values. Rhode Island and New Jersey, experimenting with such truck crops as Carrots, Lima Beans, Cucumbers, Beets, Cabbage, Peppers, Sweet Potatoes, Sweet Corn, String Beans and Egg Plants, showed an average gain of $34.24 for each dollar spent for lime.

Lime Reduces Production Costs

A PENNY saved is a two-pence earned. Cut down the cost of producing a crop and you increase your chances of profit on it. Lime fits into the program of cost reduction in two ways. First, it increases the crop yield per acre without proportionately increasing the labor or expense. As a result, it lowers the cost of each ton of hay, bushel of grain or pound of vegetables produced.

Second, lime by mellowing heavy soils reduces the cost of cultivation per acre. Actual experiments on such a soil, proved that it could be plowed one-sixth easier and 26 per cent faster after liming than before. Ten limed acres could be plowed in approximately the same time required to plow eight unlimed acres. The savings in time, power and wear on implements are often alone sufficient to pay most of the costs of liming.

It is easy to see that the increase per acre resulting from liming does not by any means represent all the profits. To the value of the crop increases must be added the actual saving in production costs. And altho this saving is frequently forgotten in figuring the benefits obtained from lime, it often equals or even exceeds in value the easily observed crop increase.

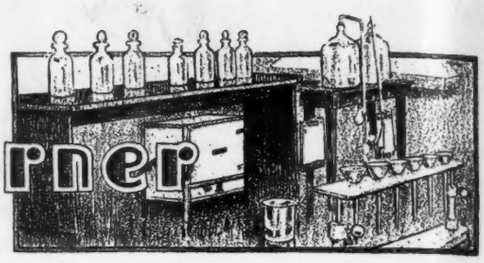
Lime is Not a Fertilizer

IT should always be remembered that lime is not a fertilizer in itself. Lime improves soil conditions, neutralizes acidity, encourages valuable bacteria, hastens the maturity of some crops such as oats and corn, controls some plant diseases such as root rot of corn and club root of cabbage, lessens the chances of winter-killing and decreases the possibility of crop failures. In other words, lime produces well-balanced growing conditions and so increases production. But always, to get production, the necessary plant foods must be in the soil or must be restored to it in the form of fertilizers and manures. A sour soil can be cured by lime alone. A worn out soil can be built up again only by adding plant foods. Soil can be equally unproductive, whether it is sour or worn out.

The National Agricultural Limestone Products Association
Secretary's Office Columbian Bldg. COLUMBUS, OHIO

Letter-advertising circular used effectively for promotion of agricultural limestone

The Chemists' Corner



The Deportment of Sand in Colloidal Solutions of Low Surface Tension

By W. E. Haskell
Oakland, Calif.

IN A PREVIOUS PAPER (Surface Tension as Related to the Plasticity of Cement Pastes, Rock Products, October 24, 1931) it was shown that the plasticity of cement pastes is increased by the use of a water solution of a colloidal material, which depresses the surface tension of the water. Since sand is also an integral part of concrete mixes, a study of its deportment, in contact with similar solutions, is obviously of value.

The behavior of sand upon the addition of small increments of water is characteristic. The sand grains become coated with a film of adsorbed water, being pushed farther apart as the thickness of the film increases, causing a bulking effect or increase in volume. Eventually a point is reached at which the films around the grains coalesce and the voids are filled with the liquid, with a consequent lessening of bulk. At the point of complete inundation the volume of sand is approximately equal of the volume of the dry rodded sand.

The sand used in these experiments was a well graded top sand of ¼-in. maximum size, suitable for use in a concrete mix, and free of detrimental amounts of silt and organic matter.

The three liquids used were water and water to which the colloidal organic admixture described in the previous paper was added. They are designated as follows:

Number	Description of liquid	Surface tension
1	Water only	72.8 dynes
2	2% solution of admixture	64.3 dynes
3	4% solution of admixture	60.1 dynes

Experimental Data

A weighed portion of the sand was thoroughly incorporated with the calculated amount of liquid and weighed in the standard 1/10th ft. measure, the measure being overfilled and struck off level. Suitable precautions were taken to insure that the mixing, filling and weighing operations were as nearly identical as possible, and each weight reported is the mean of three weighings. No large variation between the three weights was noted in any case.

From the weights per cubic foot, and the percentage of moisture, the percentage of bulking was calculated.

Table 1 and Fig. 1 show the results obtained with the three liquids, the horizontal coordinates being percentages of liquid and the vertical coordinates the percentages of bulking of the sand.

TABLE I. BULKING OF SAND

Per cent. liquid	Weight per cu. ft.	Per cent. bulking
Liquid No. 1. Water; surface tension, 72.8 dynes		
0	102.5	0
2	83.2	25.7
4	80.3	32.9
6	79.5	37.2
8	83.6	33.2
10	89.1	27.8
12	93.0	25.3
14	100.7	18.3
Liquid No. 2. Surface tension, 64.3 dynes		
0	102.5	0
2	83.5	25.3
4	81.6	30.9
6	82.0	32.9
8	86.0	29.5
10	90.6	25.7
12	95.7	21.7
14	104.9	13.6
Liquid No. 3. Surface tension, 60.1 dynes		
0	102.5	0
2	83.5	25.3
4	83.3	28.1
6	84.6	28.9
8	89.5	24.5
10	96.2	18.3
12	100.9	15.4
14	108.9	9.3

It will be seen that the maximum bulking is obtained with approximately the same amount of liquid in each case, the percentage of bulking becoming less as the surface tension decreases. Fig. 2 shows this decrease graphically.

While the operation of filling and weighing the container of wet sand is not of great accuracy, and is one into which the personal

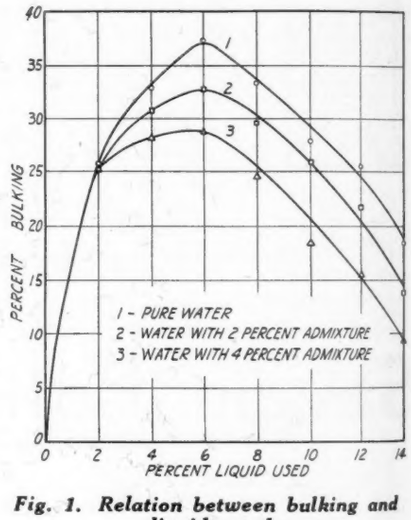


Fig. 1. Relation between bulking and liquids used

equation may largely enter, it has been possible to detect measurable differences in the bulking of the sand with the different percentages of the three liquids used. The difference in the surface tension of the liquids used is also small and while it is possible to depress the tension still further by the use of suitable reagents, it was thought to be of more value to keep the range of the experi-

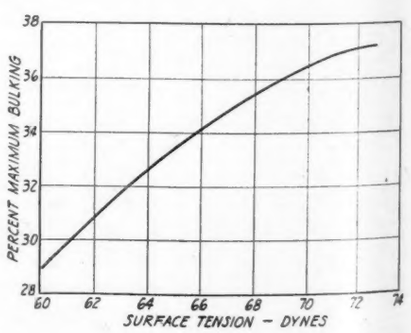


Fig. 2. Relation between bulking and surface tension

ments within that of practical and commercial use.

Conclusions

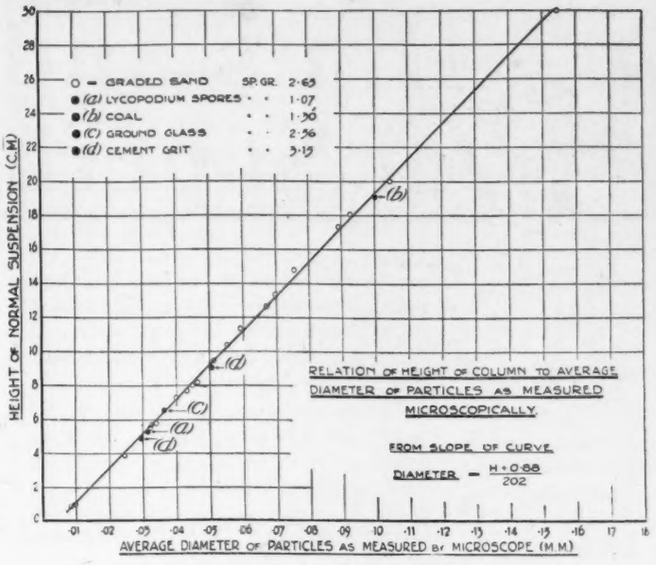
Experiments undertaken with a sample of top sand and certain colloidal organic solutions of low surface tension indicate:

(1) That the percentage of bulking of sand decreases as the surface tension of the liquid with which it is moistened decreases.

(2) That the point of maximum bulking is reached with approximately the same amounts of liquid, regardless of their surface tension.

(3) That the percentage of maximum bulking decreases with the decrease of surface tension.

(4) That the sand in a concrete mixture would probably require lesser amounts of a liquid of low surface tension, thus permitting the use of some lower ratio of water to cement.


HEIGHT OF NORMAL SUSPENSION (C.M.)
AVERAGE DIAMETER OF PARTICLES AS MEASURED BY MICROSCOPE (M.M.)
O = GRADED SAND SP. GR. 2·63
(a) LYCOPODIUM SPORES 1·07
(b) COAL 1·36
(c) GROUND GLASS 2·56
(d) CEMENT GRIT 3·19
RELATION OF HEIGHT OF COLUMN TO AVERAGE DIAMETER OF PARTICLES AS MEASURED MICROSCOPICALLY.
FROM SLOPE OF CURVE
DIAMETER = H + 0·88 / 202

Graph used with obscurometer

the diameters of these quartz particles was measured by a microscope.

There is a straight-line relationship between the height of the obscuring column and the average diameter of the particles in suspension. This is shown in the graph, and this graph may be used to read the diameters from the height directly. It may be calculated more accurately from the formula:

$$d = \frac{H + 0.88}{202}$$

in which H is the height of the obscuring column. This formula is found from the slope of the straight line plotted from heights of column and corresponding diameters.

Measurement of Cement Fine Particles

A METHOD and the apparatus for measurement of the finer particles of portland cement and similar substances is described in a British publication, *Cement and Cement Manufacture,* for July. References to this method have been made in various periodicals during the past two or three years, but this is the first complete description that has been noted.

The method consists in making a suspension of the particles to be measured in a viscous medium. Liquid parafine is used for cement and sugar solution for coal dust. The finer the particles the more of them there will be in a given volume, and if suspensions of equal volumes are compared that having the finer particles will be cloudier. The cloudiness is measured by noting the thickness or depth of solution necessary to obscure the filament of an electric lamp. The method has been adopted by the Research Department of the Associated Portland Cement Manufacturers, Ltd., a British Institution.

The simple apparatus, which is called an "obscurometer," is shown in the cut. The suspension of the material to be tested is run into the bottle *G* and allowed to flow slowly through the valve *F* into the tube *A*. Blowing into the tube *H* assists it to flow. As soon as the filament of the lamp *C* is seen to disappear, the flow is stopped and a reading taken.

To insure that the volume of powder in every case is the same a system of "normal" suspensions has been devised. The standard normal suspension is of 0.5 grams finely ground quartz sand in a solution of 150 grams pure cane sugar in 100 c.c. water. Quartz sand has a specific gravity of 2.65 and fresh cement a specific gravity of 3.15. Hence to make a normal suspension of cement the weight taken is:

$$\frac{0.5 \times 3.15}{2.65} = 0.5943 \text{ gram in 100 c.c. liquid.}$$

For coal dust with coal of a specific gravity of 1.40 the weight taken would be:

$$\frac{0.5 \times 1.4}{2.65} = 0.2641 \text{ gram in 100 c.c. liquid.}$$

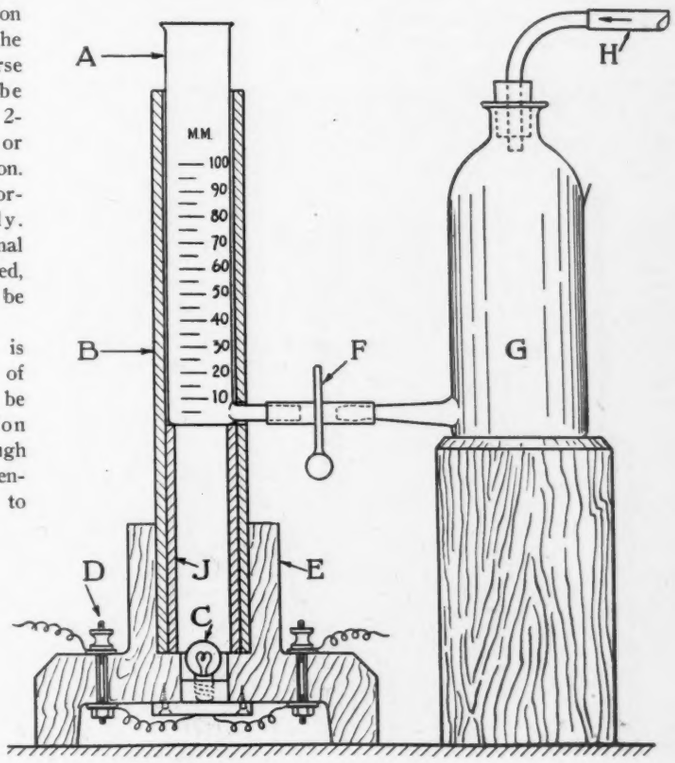
The instrument works best when the height of the column is between 3 and 5 cm. A normal suspension of very fine particles may obscure the filament with less than 1 c.c. of the suspension, which could not be read closely. So for these fine particles a ½-normal, ⅓-normal or ¼-normal suspension may be used. On the other hand, with coarse particles, it may be necessary to use a 2-normal, 3-normal or 4-normal suspension. The readings are corrected accordingly. Thus, if a ½-normal suspension were used, the reading would be divided by 2.

The instrument is limited by the size of particle that can be held in suspension without falling through the liquid. This generally confines it to particles that will pass a 200-mesh sieve.

The instrument was originally calibrated with samples of quartz sand ground to different degrees of fineness and

Standard for Feldspar

THE COMMERCIAL STANDARD for feldspar, CS23-30, has been reaffirmed without change for another year beginning September 1, 1931, or until authorized revisions are duly indorsed by the industry. This action was taken after a survey by the Bureau of Standards.



Obscurometer used in measuring cement fine particles

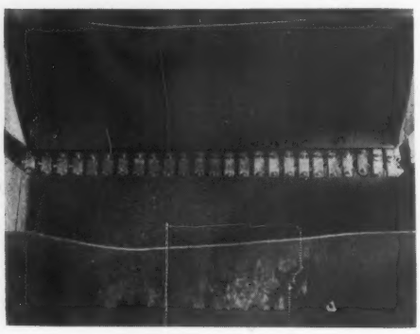
Hints and Helps for Superintendents

Bucket Elevator Has Good Service Record

By H. Irwin Reinhorn
Newark, N. J.

AN EXCEPTIONAL RECORD for service is reported on two bucket elevators in service at the plant of the Callanan Road Improvement Co., South Bethlehem, N. Y.

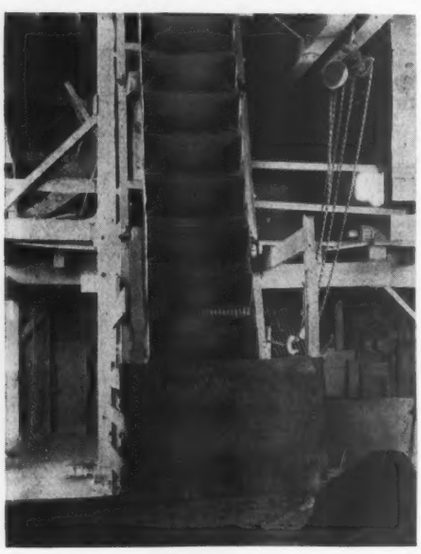
One of these is shown in an accompanying illustration. The belt is a 42-in. x 8 ply, 1/16-1/32-in. cover. It operates on an Allis-Chalmers No. 10 elevator, is 155 ft. on centers, and has a capacity of 500 tons per hour. The belt is fastened with "Flexco-H.D." belt fasteners and, with the exception of the single end fasteners on each end, there had been no replacement.



Steel lacing holds belt securely

This elevator was installed in April, 1929, and at the completion of the 1931 season was reported as "good for another half season." The fasteners were still in a satisfactory condition. In all well over 1,000,000 tons have been handled by this elevator.

A companion belt elevator with 34 in. x 10 ply belt is also reported to have given equal service at this plant.



The elevator in service

Crushing Clay Bearing Material

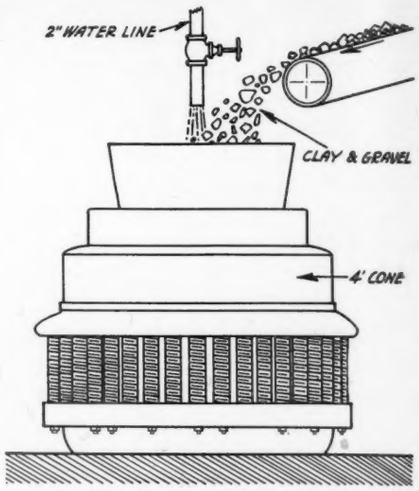
By C. C. Cooley
General Manager, Cooley Gravel Co.

WE HAVE in our deposit a high clay content called "glacial flour" which occasionally runs into clay balls and gave us no end of trouble in crushing until we installed the cone crusher.

A year ago for our secondary crushing we had a 9- x 36-in. jaw crusher and a reduction crusher. Clay balls caused packing in the reduction crusher and it was impossible to add water without getting it in the oil along with considerable grit. This resulted in the babbitt bearings wearing out rather fast, which meant delay and expense. There were many times when this crusher would "freeze" up entirely as though it had a piece of steel in it, but upon examination it would prove to be nothing more than material which had compacted between the head and concaves. There was nothing wrong with the crushers. The trouble was in the material being crushed.

With the 9- x 36-in. crusher the packing action would sometimes cause this machine to throw a belt, but most of our trouble came from hot bearings. Neither the reduction nor the jaw crusher gave satisfaction except when we were in the cleanest part of our deposit. In the consideration of this crushing problem and in talking it over with the Nordberg Manufacturing Co. we decided that it was advisable to install a cone crusher which had a capacity of twice the amount we wanted to crush. We thought by doing this that one-half the crushing area could become clogged with clay and the other half would still give us the capacity desired. We also wanted a crusher which would take a 6-in. stone and for these two reasons we purchased the 4-ft. size Symons cone crusher in preference to a 3-ft. size which, according to the manufacturers' tables, would have given us ample capacity.

The 4-ft. cone crusher was installed early in 1931. At first it appeared that it would not be necessary to add water, but after a full day's operation we decided to install a 1-in. water line. Then after getting into a less favorable place in our deposit with more clay, we found it necessary to install a 2-in. water line, which has given us plenty of water to wash through all clay encountered.



Water helps in crushing rock containing clay

It would be impossible to estimate how much water we use compared to the amount of material going through the crusher. The amount of water varies considerably, depending upon the amount of load and the amount of clay; and we have a valve which is adjusted several times during the day by the man in charge of our plant. The material from the crusher is elevated by bucket elevator and discharged on a belt conveyor. If it were not for the fact that this material was carried on a belt conveyor it would be possible to set the water supply valve well open and leave it there, but with our installation it is necessary to keep the material comparatively dry, so that it will carry on the belt conveyor.

With reference to the water getting in the oil, this condition has not altered much, if any, as we still notice a small amount of water in the oil, probably about two gallons per week is drained out of the bottom of the oil tank. As far as we can tell this water is not carrying in any grit or doing any damage to the crusher and as long as this condition exists we will probably do nothing to try to stop this water getting in the oil.

We cannot tell how much the head and concaves of the crusher have worn, but from appearances this seems to be a very small amount. We have produced approximately 90,000 tons of material so far this year (1931) and I would estimate that 50,000 tons has gone through the crusher, taking into consideration the circulating load.

Up until this year our plant was delayed a considerable amount when we were in places in the deposit where the material was heavy and of oversize gravel. This year we have not been held up at all on account of crushing capacity and we have had practically no trouble with this 4-ft. Symons cone crusher except that the distributing plate on top of the crusher head became loose several times. This trouble has been overcome by installing oversize bolts for securing this plate.

Factors Governing Life of Conveyor Belts

THE best way of expressing the life of conveyor belts is the cost of belt per ton delivered during the total life of the belt, according to C. F. Conner, B. F. Goodrich Rubber Co., Akron, Ohio, in an article in a recent issue of *Chemical and Metallurgical Engineering*. That this figure will vary widely with the type of service is shown in the tabulation, which has been compiled from records considered satisfactory by the users.

PERFORMANCE OF RUBBER CONVEYOR BELTS

	Belt length, feet	Belt width inches	Total tons handled	Dollars* per 1000 tons
Ore	610	48	37,000,000	1.01
	770	48	11,744,000	0.42
	290	42	5,228,181	0.28
	111	30	4,647,000	0.097
Coal	2400	48	19,000,000	0.76
	1775	48	4,400,000	1.70
	190	36	4,540,000	0.09
Coke	925	42	.....	7.75
	540	36	.....	2.00
	1000	42	.....	3.90
Stone	723	30	.....	1.00
	450	36	.....	0.80
	280	24	.....	0.65

*Based on belt prices now current.

The design and installation of a conveyor has a considerable bearing on its life. Protective devices are important factors in belt life. These include decking, brushes and other means of preventing material from spilling on the return side of the belt or clinging to the pulleys. Proper choice of the cover thickness has a considerable bearing on tonnage cost. Thickness should be properly balanced to meet the conditions of service so that the cover will neither outwear the carcass nor be worn out before it is.

The design of the loading chute has an important influence on wear. The ideal loading condition is for the material to be deposited on the belt at the same speed and in the same direction as the travel of the belt. When the load is permitted to drop any considerable distance, heavy lumps may rapidly cut the belt to pieces. A few dollars saved in the design of a loading chute or in the installation of brushes may take its toll ten times over in the wear of the belt. Another point to be remembered is that a belt which travels faster than is necessary to handle its load cannot be expected to deliver as much tonnage as a belt well filled. Delivery of a small load can wear the belt just as rapidly as a larger load.

Many belts are hopelessly damaged during installation or may run crooked due to failure to cut the belt square at the joint. Correct alignment of idlers and trippers avoids crooked running and edge injury. Belts that are run too tight are very liable to injury. Excessive tension may be avoided by pulley lagging or other corrective measures. Lack of proper lubrication is another cause of belt injury, for stuck idlers wear sharp and cut the belt. Still another danger point is the accumulation of material on pulleys. The purchase of cleaning devices represents a good investment.

Belt width and weight of material both influence tonnage cost, and each in a similar manner. Other factors, such as heat, corrosion, oil, abrasion, size of material and lift, all tend to increase tonnage cost as the factors become more severe.

Formula for Finding Open Area of Wire Cloth

By W. F. Schaphorst
Newark, N. J.

THE FORMULA that is generally used for finding the open area of wire cloth is somewhat cumbersome because it goes at the problem "backwards." It gives us the closed area, and then we are told to subtract that area from one. The answer will be correct, of course, but the method is clumsy. The following formula gives the open area directly:

$$\text{Open area} = (1 - ND)\ (1 - nd)$$

where N = number of wires in the warp per in.;
n = number of wires in the shoot per in.;
D = diameter of wires in the warp;
d = diameter of wires in the shoot.

To accomplish the same purpose the "old" formula, revised somewhat, would be as follows:

$$1 - ND\ (1 - nd) - nd$$

where the meaning of the symbols is the same as given above. Both formulas give the same result, to be sure, but the first is certainly simpler, is it not?

Sand Launders

THE WEAR that a launder receives in the sand industry needs no elaboration here. Where the launder has a small grade its size to carry off a given amount of solids must be larger than where the grade is steep. This is obvious. But to construct a long-life launder of spacious dimensions and do it cheaply is another matter.

The Inland Lime and Stone Co. at Manistique, Mich., crushes and prepares a large tonnage of flux and commercial stone. Some of the fines are saved by means of a sand drag. The overflow from the sand drag passes through a long launder made by splitting a 30-in. clay pipe and bonding the joints with concrete. The accompanying illustration shows the launder. Advantage is taken of the natural slope of the ground.

Launder built of 30-in. split clay tile

Rock Products Clinic

What About the Pacific Coast? —Let a Californian Tell It

THE EDITOR: The general contention the country over has been that the Pacific Coast was better off in every way than any other part of the country. This is possibly true to a certain extent, but the depression (if one can call the period just past a depression) has wrought its havoc in the far west as it has the world over. This condition will right itself as time rolls on, but in the place of inflated values the world in general will recover its balance on a more stable basis. The Pacific Coast is sure to share in the prosperity that is bound to come in the future, by reason of the fact that the majority of the people in the United States, and the world for that matter, want to come to California and the other Coast states. The influx of people who come west to make their homes contribute to the welfare of the west. There is no questioning the fact that where the majority of population is, is where one finds the most business; and active business means prosperity.

The crushed rock business in the west has suffered through this slump as has the balance of the business of this vast empire west of the Rockies, but the firms that have hung on desperately have a wonderful chance to bloom forth again and be bigger and better organizations than ever before. The heads of the great companies in this country along the Pacific are to be congratulated on the stand they have taken in the matter of wages. From close observations it has been my pleasure to find that wages have been lowered to a very small degree, and it is my opinion that this stand to maintain wages to as high a level as possible has contributed to the welfare of this section of the country.

In the Los Angeles district a tremendous tonnage of crushed rock is to be consumed in the next few years. The great aqueduct from the Boulder Dam will be a crushed rock consumer from its start to finish. To anyone who has sojourned on the vast stretches of this great Mojave desert, the picture of the building of this $220,000,000 project will readily show the enormous amount of rock-crushing equipment it will need. The country through which this aqueduct will run is a rough country indeed, with the high San Bernardino mountains to tunnel through, and miles upon miles of sand will be encountered. Rattlesnakes in conjunction with the boiling summer sun, bad water along the route, and the loneliness of the desert will tend to dishearten all but the strongest.

While on the subject I want to paint a word picture of the courage of some of these men who have passed through this Barstow district en route afoot on these blistering highways in July and August to Boulder Dam to look for work. This last July two men succumbed to the terrific heat just about 15 miles east of Yermo, Calif. These men had drunk their fill in Yermo, but their physical conditions were bad due to tramping day after day with scarcely enough to eat, and after starting across those hot sandy stretches east of Yermo, they simply lay down and died in the same fashion as did our forefathers who crossed these blistering wastes in the days of '49. True, these men start on these trips with hopes builded in their breasts that some passing motorist will pick them up, but robberies, hold-ups and even murders have frightened most motorists into passing them all by. Truly the Boulder Dam is in an isolated part of our country and to the brave souls who will tread these hundreds of miles of desert in heat as high as 140 deg. to look for work, much praise should be given.

The cement plants here in California are marking time until the big rush of pouring concrete starts on the Boulder Dam. Most of the major cement companies will share in this coveted business. The use of concrete in the metropolitan district of Los Angeles is approximately 20% of normal. This fact is because office and business buildings were overdone in the past few years with the result that many vacancies exist. Home building in this same district is on a better basis. All this retarded building reflects on the rock industry, which in turn has a poor effect on the rock crushing and screening manufacturing companies.

Worthy of comment is the fact that a new silica grinding plant is being built about 35 miles east of Barstow on the main line of the Union Pacific railroad. This plant will specialize in certain grades of silica not to be obtained from the large silica sand deposits in the West. The mill is equipped with Williams hammer mills and vibrating screens. Near the mill are a series of washing tanks that will be utilized for a special product.

The outlook for certain lines of machinery on the coast is not so good. Any number of various sizes of plants have been dismantled, and the machinery from these plants has piled up on the machinery dealers' hands, until today it is really difficult to sell anyone a new piece of equipment of any kind. Due to the state of California doing a tremendous amount of work on its highways in an endeavor to assist the unemployed, there has been a fair demand for road working machinery.

On a recent tour of the East I paid particular attention to the conditions in general as compared to the West, and I found the West much superior in every way in so far as general prosperity goes. To any of you readers let me say, however, don't let this statement influence you in any way about deciding to come West to make your fortunes. Jobs of every description are filled. The large cities are distressed in caring for those who cannot find work. Labor camps have been put into existence, whereby a man can work on construction work 6 hours a day for his meals and a place to sleep. This is fine for single men, but doesn't help the married man with a family of children. There happens to be (at this writing) 75 men on the waiting list in this small city of Barstow waiting to get work on the county roads, three days a week.

I am aware of the fact that this article is on an off tangent to what you would expect to read in ROCK PRODUCTS, but I do know it will interest you to know some of the facts existing in this western country.

CHARLES JENKINS, Superintendent,
Pacific Minerals Co., Barstow, Calif.

More About Specifications for Aggregates

THE EDITOR: I notice with much interest page 58 of the December 5 issue of ROCK PRODUCTS—subject "Rock Products Clinic," signed by Earl S. Casey of Escondido, Calif. I concur in the statement of Mr. Casey in every respect, due to the fact that we have gone through long experiments with aggregates, the effective size of which on the materials used, particularly in California, is not uniform and is based wholly upon materials available at the time the State, County and Pacific codes were instituted as a matter of standard practice.

The fact of the matter is that there are better materials produced today that will bring about better concrete aggregate with greater compressive strength, better waterproofing and acid-proofing, and efflorescence elimination, than has been offered before; and with a greater binder ability, due to the fact that the types of material produced from silica sand can be added to the common type of sand used on any local job to fill the void displacement from the standard of screen mesh between low concrete aggregate and the cement; manifestly raising the building insurance to a decided degree.

We produce a "siliceous fines," minus 60-mesh, 90% of which is through 100, which in experimental tests raises the compressive strength 1000 lb. per sq. in. The material is so cheap that there is no reason why it should not be used from the standpoint of its efficiency if for no other reason. The great difficulty is the changing of the adopted code specifications for materials, which is more or less political in nature, and, because of least resistance engineers and architects do not, apparently, want to change, even though research has developed better things every year.

J. A. BENELL, President,
The Crystal Silica Sand Co.,
Los Angeles, Calif.

Editorial Comment

We Favor a Public Works Bond Issue

It is our observation and belief that the majority of any group of American business men always *desire* to do the *right thing,* both as concerns their government and society; and this desire is greater even than the natural selfish desire for the profit of their individual business or the particular industry their business is in. Recently we listened among a group of producers to a discussion of pending highway legislation before Congress, and there was a sincere difference of opinion based entirely on broad issues of what was best for the country.

The proposed highway legislation, however, is a side issue, for the larger question before the country is whether or not its budget should be balanced *as soon as possible.* Probably there is no difference of opinion as to whether or not it should be balanced over a term of years. Most arguments in favor of immediate balancing are drawn from comparisons with private business.

But in the case of accumulating a temporary deficit the United States government is not like an individual business enterprise. In the first place its life is not limited as is that of an ordinary business. In the second place it has practically unlimited credit, at least limited only by the total wealth of its citizens, because by various devices it can compel even unwilling lenders to buy its securities or be taxed out of their wealth.

Again, there is a vast difference between the recognized *objectives* of business or industry and of government. The purpose of business is profit to its promoters or organizers; the purpose of government is the security and welfare of its citizens. Eventually, we are confident, enlightened business men will more and more see that the objective of business and industry has far more in common with the objective of government than is the opposite case. As it is now many business men are trying to visualize government as a business. True, of course, that principles of business management may be applied profitably to public administration, but in matters of broad determining policy, we must not overlook the fact that the objectives of government and business (as now conducted) are not the same; consequently many current arguments based on an assumed analogy are fallacious.

In a national emergency such as this country faced in 1916-18 there was no concern over a budget vastly more unbalanced than our present one. But the psychology of the people, including business men, was very different. We were thoroughly imbued with a patriotic sense of our own strength in finance, resources, brains and energy. We never for a moment doubted our capacity ultimately to lift our debt. And we have indeed lifted about one-third of this war debt in the interim. Had the financial policy of the country in the last twelve years been wiser, and had taxes been maintained at a level that business could then very well have shouldered, we probably would have paid off a good deal more.

The point is that the time to collect taxes and pay debts is during prosperity. The individual business enterprise has not sufficient resources to finance itself on its usual scale very long in hard times. Loading it down then with taxes of various kinds obviously does not help its recovery. Instead, this causes cutting of budgets, dividends, wages, number of employes, and brings on all kinds of industrial and economic distress; not primarily from overproduction but because these measures themselves result in extraordinary curtailments of purchasing power. The federal government *does* have the resources to maintain or even increase its expenditures in hard times. It has a long period in which to balance its budget.

It is now generally appreciated that balancing budgets is something that should work both ways for the future safety and security of both government and business. The economic problem of the big surplus is just as serious as the problem of the big deficit. If the government uses its surplus in flush times to build up unnecessary bureaucracy and governmental superstructures instead of amortizing its debt, the men responsible for government fail to use good judgment. If business uses its surplus to loan for stock-market gambling, or to build new and unnecessary producing facilities, the management of that business uses poor judgment. The government might better have taken a larger part of that surplus in more taxes. The ultimate result of enough poor judgment is disaster to both business and government. And it is you and I and the other fellow who must supply the necessary judgment!

It seems to us that all this agitation over immediate balancing of the government's budget is merely another manifestation of our loss of self-confidence and business morale. In times of war we are never afraid to assume any amount of indebtedness. To our mind the "horrible examples" held up to us, of European nations and their unbalanced budgets, could just as well be accounted for by a shaken morale as by government extravagance.

No individual business man with self-confidence shies at assuming indebtedness for productive enterprise. We see no logical reason why a strong national government of a country rich in undeveloped resources should be afraid to assume indebtedness to develop those resources. Our present debt may seem large in comparison with present tangible wealth, but will it appear so large in comparison with the wealth we may still develop—that millions of unemployed are anxious for an opportunity to develop?

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[27]	3-23-32	94	.....	
Alpha P. C. com.[2]	3-21-32	8	9	25c qu. Apr. 25
Alpha P. C. pfd.[2]	3-21-32	80	90	1.75 qu. Mar. 15
Amalgamated Phosphate Co. 6's, 1936[10]	3-18-32	85	.....	
American Aggregates com.[19]	3-18-32	1¼	4	
American Aggregates pfd.[19]	3-18-32	5	15	1.75 qu. Jan. 1
Amer. Aggr. 6's, w.w.[19]	3-18-32	25	35	
Amer. Aggr. 6's, ex.w.[19]	3-18-32	24	34	
Amer. L. & S. 1st 7's[27]	3-23-32	70	75	
American Silica Corp. 6½'s[29]	3-23-32	No market		
Arundel Corp. new com.	3-11-32	23 actual sale		75c qu. Apr. 1
Bessemer L. & C. Class A	3-22-32	.....	13½	
Bessemer L. & C. 1st 6½'s[27]	3-18-32	25	50	
Bloomington Limestone 6's[27]	3-23-32	.....	25	
Boston S. & G. new com.[37]	3-18-32	4	7	15c qu. Jan. 2
Boston S. & G. new 7% pfd.[37]	3-18-32	30	35	87½c qu. Jan. 2
California Art Tile, A	3-18-32	1½	5¼	
California Art Tile, B[40]	3-17-32	.....	2½	
Calaveras Cement com.	3-18-32	.....	2	
Calaveras Cement 7% pfd.	3-18-32	50	56	1.75 qu. Apr. 15
Canada Cement com.	3-22-32	6	6¼	
Canada Cement pfd.	3-22-32	59¾	60	1.62½ qu. Mar. 31
Canada Cement 5½'s[42]	3-17-32	89	91	
Canada Crushed Stone bonds[42]	3-17-32	60	65	
Canada Crushed Stone com.[42]	3-17-32	5	.....	
Certainteed Products com.	3-22-32	2½	3	
Certainteed Products pfd.	3-22-32	11	22	1.75 qu. Jan. 1
Cleveland Quarries	3-22-32	.....	54	25c qu. Mar. 1
Consol. Cement 1st 6½'s, A[44]	3-23-32	4	8	
Consol. Cement notes, 1941[27]	3-23-32	No market		
Consol. Cement pfd.[27]	3-23-32	.....	50	
Consolidated Oka Sand and Gravel (Canada) 6½'s[42]	3-19-32	85	90	
Consolidated Oka Sand and Gravel (Canada) pfd.[41]	3-15-32	47½	.....	1.75 qu. Oct.10,'31
Consol. Rock Prod. com.[9]	3-17-32	25c	35c	
Consol. Rock Prod. pfd.[9]	3-17-32	2	2½	
Consol. Rock Prod. units[25]	3-17-32	1½	2½	
Consol. S. & G. pfd. (Can.)	3-22-32	35	.....	1.75 qu. Feb. 15
Construction Mat. com.	3-22-32	⅞	2	
Construction Mat. pfd.	3-22-32	1	5	
Consumers Rock and Gravel, 1st Mtg. 6's. 1948[35]	3-17-32	35	40	
Coosa P. C. 1st 6's[27]	3-23-32	20	25	
Coplay Cem. Mfg. 1st 6's[33]	3-18-32	50	70	
Coplay Cem. Mfg. com.[33]	3-18-32	5	7½	
Coplay Cem. Mfg. pfd.[33]	3-18-32	25	40	
Dewey P. C. com.[47]	3-23-32	95	105	
Dolese and Shepard	3-22-32	18	20	$1 qu. Jan. 1
Dufferin Pav. & Cr. Stone pfd.	3-22-32	.....	54	1.75 qu. Apr. 1
Dufferin Pav. & Cr. Stone com.	3-22-32	2	4	
Edison P. C. com.[32]	3-18-32	1½	.....	
Edison P. C. pfd.[32]	3-18-32	5	.....	
Federal P. C. 6½'s, 1941[19]	3-18-32	66	.....	
Giant P. C. com.[2]	3-21-32	2	4	
Giant P. C. pfd.[2]	3-21-32	7	10	1.75 s.-a. Dec. 15
Gyp. Lime & Alabastine, Ltd.	3-22-32	4	4⅛	10c qu. Oct.5,'31
Gyp. Lime & Alabastine 5½'s[42]	3-17-32	58	61	
Hermitage Cement com.[11]	3-19-32	2	7	
Hermitage Cement pfd.[11]	3-19-32	30	35	
Ideal Cement 5's, 1943[29]	3-19-32	90	95	
Ideal Cement com.	3-22-32	18	20	50c qu. Apr. 1
Indiana Limestone units[27]	3-23-32	No market		
Indiana Limestone 6's	3-19-32	12 actual sale		
International Cem. com.	3-22-32	13⅜	13⅝	50c qu. Mar. 31
International Cem. bonds, 5's	3-22-32	63 actual sale		Semi-ann. int.
Iron City Sand & Gravel 6's[36]	3-18-32	.....	70	
Kelley Is. L. & T. new stock	3-22-32	12½	13½	25c qu. Jan. 1
Ky. Cons. Stone com.	3-22-32	.....	2	
Ky. Cons. Stone pfd.	3-22-32	.....	50	1.75 qu.
Ky. Cons. St. 1st Mtg. 6½'s[45]	3-17-32	30	40	
Ky. Cons. St. V. T. C.[45]	3-17-32	50c	1	
Ky. Rock Asphalt com.	3-22-32	1¾	2½	
Ky. Rock Asphalt pfd.	3-22-32	20	25	1.75 qu. Dec.1,'31
Ky. Rock Asphalt 6½'s	3-22-32	81½	85	
Lawrence P. C.[2]	3-21-32	10	14	
Lawrence P. C. 5½'s, 1942[2]	3-21-32	42	45	
Lehigh P. C. com.	3-22-32	4½	4⅝	
Lehigh P. C. pfd.	3-22-32	64¼	65½	1.75 qu. Apr. 1
Louisville Cement[45]	3-22-32	175	225	
Lyman-Richey 1st 6's, 1932[13]	3-18-32	95	.....	
Lyman-Richey 1st 6's, 1935[13]	3-18-32	90	.....	
Marblehead Lime 6's[14]	3-18-32	No market		
Marbelite Corp. com.[35] (cement products)	3-17-32	.....	75c	
Marbelite Corp. pfd.[35]	3-17-32	1	.....	
Marquette Cem. Mfg. 1st 5's, 1936[46]	3-23-32	85	.....	
Marquette Cem. Mfg. 1st 6's, 1936[46]	3-23-32	90	.....	
Material Service Corp.	3-22-32	12	13½	
McCrady-Rodgers 7% pfd.[22]	3-17-32	40	42	87½c qu. Dec. 30, 1931
McCrady-Rodgers com.[22]	3-17-32	5	10	75c qu. Jan. 26
Medusa P. C. pfd.[47]	3-23-32	50	60	
Medusa P. C. com.	3-22-32	9½	12	
Monarch Cement com.[47]	3-23-32	60	65	
Michigan L. & C. com.[6]	3-19-32	45	.....	
Missouri P. C.	3-22-32	8	10	25c qu. Jan. 30
Monolith Portland Midwest com.[9]	3-17-32	75c	1	
Monolith P. C. com.	3-19-32	1⅛	.....	40c s.-a. Jan. 1
Monolith P. C. pfd.	3-19-32	2⅞	.....	40c s..-a. Jan. 1
Monolith P. C. units[9]	3-17-32	8½	10	
Monolith P. C. 1st Mtg. 6's[9]	3-17-32	65	70	
National Cem. (Can.) 1st 7's[27]	3-23-32	90	95	
National Gypsum A com.[27]	3-23-32	2	3	
National Gypsum pfd.[27]	3-23-32	33	35	1.75 qu. Apr. 1
National Gypsum 6's[8]	3-24-32	55	60	
Newaygo P. C. 1st 6½'s[27]	3-23-32	79	.....	
New England Lime 6's, 1935[14]	3-18-32	11	15	
N. Y. Trap Rock 1st 6's	3-22-32	68½ actual sale		
N. Y. Trap Rock 7% pfd.[30]	3- 4-32	52	.....	1.75 qu. Apr. 1
North Amer. Cem. 1st 6½'s	3-22-32	20½ actual sale		
North Amer. Cem. com.[27]	3-23-32	½	1	
North Amer. Cem. 7% pfd.[27]	3-23-32	1	4	
North Shore Mat. 1st 5's[15]	3-23-32	No market		
Northwestern States P. C.[47]	3-23-32	25	30	
Ohio River S. & G. com.	3-22-32	.....	8	
Ohio River S. & G. 7% pfd.	3-22-32	.....	98	
Ohio River S. & G. 6's[16]	3- 5-32	70	80	
Oregon P. C. com.[9]	3-17-32	8	12	
Oregon P. C. pfd.[9]	3-17-32	80	85	
Pacific Coast Aggr. com.[40]	3-17-32	.....	50c	
Pacific Coast Aggr. pfd.[40]	3-17-32	.....	1	
Pacific Coast Aggr. 6½'s, 1944[5]	3-17-32	21	24	
Pacific Coast Aggr. 7's, 1939[5]	3-17-32	3	6	
Pacific Coast Cement 6's[5]	3-17-32	80	.....	
Pacific P. C. com.	3-18-32	3	8	
Pacific P. C. pfd.	3-18-32	.....	48	1.62½ qu. Jan. 5
Pacific P. C. 6's[5]	3-17-32	92½	.....	
Peerless Cement com.[1]	3-19-32	25c	75c	
Peerless Cement pfd.[1]	3-19-32	5	10	
Penn.-Dixie Cement com.	3-21-32	⅝	1¼	
Penn.-Dixie Cement pfd.	3-21-32	5⅛	6⅜	
Penn.-Dixie Cement 6's	3-21-32	42¾ actual sale		
Penn. Glass Sand Crop. pfd.	2- 3-32	65	75	1.75 qu. Apr. 1
Penn. Glass Sand Corp. 6's	3- 2-32	83	85	
Petoskey P. C.	3-22-32	2½	3	
Port Stockton Cem. com.[9]	3-17-32	No market		
Riverside Cement com.[9]	3-17-32	.....	12	
Riverside Cement pfd.[9]	3-17-32	55	60	1.50 qu. Feb.1
Riverside Cement, A	3-18-32	.....	8	
Riverside Cement, B[9]	3-17-32	70c	1	
Roquemore Gravel 6½'s[17]	3-18-32	90	98	
Sandusky Cement 6½'s, 1932-37[19]	3-18-32	85	95	
Santa Cruz P. C. com.	3-18-32	.....	75	$1 qu. Apr. 1
Schumacher Wallboard com.	3-18-32	1½	.....	
Schumacher Wallboard pfd.	3-18-32	.....	23½	50c qu. Feb. 15
Southwestern P. C. units[35]	3-17-32	150	.....	
Standard Paving & Mat. (Canada) com.	3-22-32	2⅜	.....	
Standard Paving & Mat. pfd.	3-22-32	.....	35	1.75 qu. Feb. 5
Superior P. C., A	3-18-32	27	30	27½c mo. Apr. 1
Superior P. C., B	3-18-32	6⅜	8	12½c Mar. 21
Trinity P. C., units[47]	3-23-32	30	40	
Trinity P. C. com.[31]	2-23-32	10	.....	
U. S. Gypsum com.	3-22-32	21¼	22	40c qu. Mar. 31
U. S. Gypsum pfd.	3-22-32	108¼	113	1.75 qu. Mar. 31
Wabash P. C.[21]	3-19-32	8	10	
Warner Co. com.[16]	3- 5-32	4½	6	25c qu. Oct.15,'31
Warner Co. 1st 7% pfd.[16]	3- 5-32	60	70	1.75 qu. Apr. 1
Warner Co. 6's, 1944, with war.	3-22-32	65 actual sale		
Whitehall Cem. Mfg. com.[30]	3- 4-32	.....	90	
Whitehall Cem. Mfg. pfd.[30]	3- 4-32	.....	50	
Wisconsin L. & C. 1st 6's[15]	3-23-32	40	.....	
Wolverine P. C. com.	3-22-32	1	1½	15c qu. Nov.15,'31
Yosemite P. C. A. com.[9]	3-17-32	1	1½	

Quotations by: [1]Watling Lerchen & Hayes Co., Detroit, Mich. [2]Bristol & Willett, New York. [3]Rogers, Tracy Co., Chicago. [4]Butler, Beadling & Co., Youngstown, Ohio. [5]Smith, Camp & Riley, San Francisco, Calif. [6]Frederick H. Hatch & Co., New York. [7]J. J. B. Hilliard & Son, Louisville, Ky. [8]Dillon, Read & Co., Chicago, Ill. [9]A. E. White Co., San Francisco, Calif. [10]Lee Higginson & Co., Boston and Chicago. [11]J. W. Jakes & Co., Nashville, Tenn. [12]James Richardson & Sons, Ltd., Winnipeg, Man. [13]Stern Bros. & Co., Kansas City, Mo. [14]First Wisconsin Co., Milwaukee, Wis. [15]Central-Republic Bank & Trust Co., Chicago. [16]J. S. Wilson, Jr., Baltimore, Md. [17]Citizens Southern Co., Savannah, Ga. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hewitt, Ladin & Co., New York. [20]Tucker, Hunter, Dulin & Co., San Francisco, Calif. [21]Baker, Simonds & Co., Inc., Detroit, Mich. [22]Peoples-Pittsburgh Trust Co., Pittsburgh, Penn. [23]Howard R. Taylor & Co., Baltimore. [24]Richards & Co., Philadelphia, Penn. [25]Hincks Bros. & Co., Bridgeport, Conn. [26]Bank of Republic, Chicago, Ill. [27]National City Co., Chicago, Ill. [28]Chicago Trust Co., Chicago, Ill. [29]Boettcher-Newton & Co., Denver. [30]Hanson and Hanson, New York. [31]S. F. Holzinger & Co., Milwaukee, Wis. [32]Tobey and Kirk, New York. [33]Steiner, Rouse and Co., New York. [34]Jones, Heward & Co., Montreal, Que. [35]Tenney, Williams & Co., Los Angeles, Calif. [36]Stein Bros. & Boyce, Baltimore, Md. [37]Wise, Hobbs & Arnold, Boston. [38]E. W. Hays & Co., Louisville, Ky. [39]Blythe Witter & Co., Chicago, Ill. [40]Martin Judge Co., San Francisco, Calif. [41]A. J. Pattison Jr. & Co. Ltd., Toronto, Canada. [42]Nesbitt, Thomson & Co., Toronto. [44]E. H. Rollins, Chicago. [45]Dunlap, Wakefield & Co., Louisville, Ky. [46]First Union Trust & Savings Bank, Chicago. [47]Anderson Plotz and Co., Chicago, Ill.

Lehigh Portland Cement Co.'s Annual Report

THE ANNUAL REPORT of the Lehigh Portland Cement Co., for the year ended December 31, 1931, contains the following:

Because the government has adopted the calendar year as the basis for commercial statistics for the cement industry, it was deemed advisable to change the accounting period of the company from the fiscal year ending November 30 to the calendar year ending December 31. This change has made it impossible to set up comparative balance sheets in the manner heretofore submitted.

Operations for the month of December, 1930, resulted in a loss of $88,520.68. Net earnings, after provision for depreciation and taxes for the calendar year 1931, were $79,328.07, as compared with $2,105,993.12 for the fiscal year ended November 30, 1930. Four quarterly dividends on the preferred stock (including the disbursement paid January 2, 1932) and one dividend on the common stock (paid May 1, 1931) have been deducted from 1931 earnings, resulting in an impairment of $1,379,411.68 to surplus.

There were acquired for cancellation during the thirteen months ended December 31, 1931, 7375 shares of preferred stock. The number of preferred shares thus far acquired for retirement since the date of issue February 1, 1928, totals 27,580 shares or 12% of the total shares originally issued. The total number of preferred shares required to be retired as of December 31, 1931, under the provisions of issue, was 13,512 shares. The company, therefore, has set up a future credit equivalent to slightly more than four years' sinking fund requirements.

The liquid position of the company is reflected by the items of U. S. Government bonds and treasury certificates $7,087,818.75, cash $3,674,692.95, and state, county, municipal, and short-term railroad equipment trust certificates $1,067,554.98, making a total of $11,830,066.68.

Two quarterly dividends (paid January 1, 1931, and April 1, 1931) on the 7% class A stock of the Great Lakes Portland Cement Corp. held by this company, aggregating $78,750, were received and credited to income.

During the thirteen months ended December 31, 1931, there were charged against earnings $1,966,778.32 for depreciation, obsolescence, and accrued renewals. The depreciation for the parent company amounted to $149,396.56 for the month of December, 1930, and $1,736,295.67 for the calendar year 1931, as against $1,994,447.14 for the fiscal year ended November 30, 1930. The reduction is largely accounted for by the fact that the company wrote off completey during 1930 the net book value of four mills, amounting to $2,808,762.29. On December 31, 1931, the provision for depreciated property totaled $20,132,684.39.

In spite of a gradual decline in the consumption of cement in the United States

CONSOLIDATED STATEMENT OF PROFIT AND LOSS OF THE LEHIGH PORTLAND CEMENT CO.

(For the 13 months ended December 31, 1931)

	Month of December, 1930	Year ended Dec. 31, 1931
Sales, less discounts, allowances, etc.	$ 610,361.77	$12,292,369.12
Cost of sales:		
Manufacturing and shipping cost	$ 321,956.40	$ 8,372,519.35
Provision for depreciation, obsolescence and accrued renewals	155,625.78	1,811,152.54
Total cost of sales	$ 477,582.18	$10,183,671.89
Manufacturing profit	$ 132,779.59	$ 2,108,697.23
Selling, administrative and general expense	$ 234,044.25	$ 2,370,728.38
	$ 101,264.66	$ 262,031.15
Miscellaneous income	29,693.88	341,359.22
	$ 71,570.78	$ 79,328.07
Provision for federal income taxes, prior years	16,949.90	
Net loss or net income carried to surplus account	$ 88,520.68	$ 79,328.07

CONSOLIDATED BALANCE SHEET OF THE LEHIGH PORTLAND CEMENT CO.

ASSETS

Plant accounts:		
Land, buildings, machinery and equipment, etc., at cost	$48,695,408.01	
Less—Reserve for depreciation	20,132,684.39	
	$28,562,723.62	
Mineral deposits, less depletion	1,646,275.64	
		$30,208,999.26
Investments and advances:		
Investment in and advances to affiliated company not wholly owned	$ 2,792,960.33	
Miscellaneous investment at cost (market value approximately $1,026.000):		
Pennsylvania state, county and municipal bonds, etc.	$601,000.19	
Short-term railroad equipment trust certificates ($119,927.80 maturing during 1932)	392,128.85	
Sundry stocks and bonds, etc.	74,425.94	
	1,067,554.98	
Workmen's compensation insurance fund invested in U. S. Government obligations	347,693.23	
Treasury stock—2857 shares of common stock at cost	61,844.20	
		4,270,052.74
Current assets:		
Cash	$ 3,674,692.95	
U. S. Government bonds and treasury certificates at cost (market value approximately $6,725,000)	7,087,818.75	
Impressed funds and advances	204,695.27	
Accounts and bills receivable, less reserves for discounts and doubtful accounts	1,141,894.57	
Inventories of finished cement, work in process, etc., at cost or market, whichever is lower	2,409,752.42	
Inventory of machinery parts and supplies—at cost	804,339.39	
		15,323,193.35
Deferred charges:		
Unabsorbed stripping charges, etc.	$ 1,120,917.48	
Prepaid insurance	22,561.08	
		1,143,478.56
		$50,945,723.91

CONSOLIDATED BALANCE SHEET OF THE LEHIGH PORTLAND CEMENT CO.

LIABILITIES

Capital stock:		
Preferred—7% cumulative: Authorized, 300,000 shares of $100 each; issued, 225,174 shares	$22,517,400.00	
Less—Retired and purchased for retirement, 27,580 shares	2,758,000.00	
	$19,759,400.00	
Common—Authorized, 600,000 shares of $50 each; issued, 450,348 shares	$22,517,400.00	
		$42,276,800.00
Current liabilities:		
Accounts payable	$ 226,754.80	
Accrued wages, salaries and general taxes	261,028.89	
		487,783.69
Reserves:		
Returnable cotton duck bags	$ 10,721.88	
Compensation and fire insurance reserves	814,801.48	
		825,523.36
Unrealized appreciation arising from appraisal of mineral deposits as of March 1, 1913		375,500.33
Surplus		6,980,116.53
		$50,945,723.91

STATEMENT OF CONSOLIDATED SURPLUS OF THE LEHIGH PORTLAND CEMENT CO.

(As at December 31, 1931)

Surplus of Lehigh Portland Cement Co., November 30, 1930		$ 8,359,528.21
Net surplus, etc., of wholly owned subsidiary companies at November 30, 1930, not previously consolidated		60,135.43
		$ 8,419,663.64
Net loss for the month of December, 1930		88,520.68
		$8,331,142.96
Add:		
Net income for the year ended December 31, 1931		79,328.07
Adjustment of unrealized appreciation for stone removed		18,523.16
Net discount on 7375 shares of 7% cumulative preferred stock purchased for retirement (credit herein as partial offset against premiums on preferred stock charged to surplus in prior years)		67,894.34
		$ 8,496,888.53
Deduct—Cash dividends:		
On preferred stock	$1,404,439.75	
On common stock	112,332.25	
		1,516,772.00
Balance of surplus December 31, 1931, carried to balance sheet		$ 6,980,116.53

during 1929 and 1930, there was an abrupt drop in total shipments in 1931 of 32,279,000 bbl., or more than 20%, as against 1930. Decreased demand and excessive overcapacity resulted in sharp reductions in prices throughout the entire country,

During 1931 six of the thirteen Lehigh plants in operation had perfect safety records. These six plants have been awarded the highly prized trophies of the Portland Cement Association for 100% safety performance. The Iola, Kan., mill has been operated from September 9, 1926, to date without a lost-time accident, thereby setting an all-time record for safety performance in the cement industry.

In the United States today there are only seven plants which have been operated continuously for more than 1000 days without a lost-time accident. Three of these seven are Lehigh plants—the Iola, Kan., plant with a clear record of more than five years and the Ormrod No. 2, Penn., and Birmingham, Ala., plants with clear records of more than three years.

Although, because of the present economic situation, it is difficult to make a forecast of marketing possibilities for cement for 1932, it is probable that the consumption of cement in the United States during the present calendar year will be less than in 1931. Government construction work will doubtlessly not be continued on the same scale as in normal years. State and county appropriations for highway work have already been greatly curtailed. General building operations will be more restricted this year than last, particularly during the first six months. On the whole, the prospects for 1932 business are not promising and, unless some artificial stimulation is injected, the cement industry must face a further shrinkage in volume.

National Gypsum Co.'s Annual Report

THE ANNUAL REPORT to the stockholders of the National Gypsum Co., Buffalo, N. Y., is reported to contain the following:

The company's net profit for the year ending December 31, 1931, was $276,990.83, after deducting fixed charges, depreciation and bond interest.

This is equivalent to $10.53 per share on the 26,295⅔ shares of preferred stock outstanding. It compares with a net of $51,-964.16 for 1930, reflecting an increase of $225,026.67.

Tonnage shipped was off about 11%, but sales in dollar value were ahead of 1929 and practically the same as 1930. Manufacturing costs were the lowest ever. Heavy curtailment in new building restricted the sale of plaster and lime; however, this was offset by more business on products used largely for building repairs, by greater effort on specialties and by the development of new wallboards.

CONSOLIDATED BALANCE SHEET OF THE NATIONAL GYPSUM CO.
(As of Decmeber 31, 1931)

ASSETS

Current			
Cash funds and certificates of deposit		$ 132,581.82	
U. S. Govenment securities at market		306,494.97	
Notes and acceptances	$ 58,066.42		
Less: allowance	9,000.00	49,066.42	
Accounts receivable	$425,527.99		
Less: allowance	66,900.00	358,627.99	
Inventory based on cost		242,493.74	
Total current assets			$1,089,264.94
Gypsum and lime deposits owned and leased—at cost and/or appraised values, less depletion to date			2,952,906.51
Other assets			
Treasury stock—480 shares preferred, at cost		17,417.50	
Class "A" stock subscriptions—employes'		26,591.25	
Miscellaneous notes and accounts receivable—net		19,862.87	63,871.62
Plant, equipment, etc.			
Land		$ 48,500.00	
Buildings, machinery and equipment	$2,677,659.87		
Less: allowance for depreciation	485,580.76	2,192,079.11	
Mine equipment and development	$ 140,200.68		
Less: allowance for amortization	3,511.47	136,689.21	2,377,268.32
Patents and trademarks			
At cost		$ 61,397.67	
Less: amortization to date		10,291.41	51,106.26
Deferred charges			
Stripping costs, less amortization to date		$ 99,880.38	
Supplies and other prepaid expense		73,776.64	173,657.02
			$6,708,074.67

LIABILITIES

Current			
Accounts payable		$ 79,152.27	
Accrued interest, taxes, etc.		15,852.81	
Total current liabilities			$ 95,005.08
Liability on license agreement—Payable monthly at rate of 1½% on board sales			108,592.45
Mortgage payable on gypsum land—Due 1936			12,000.00
6% sinking fund gold bonds, 1943—Outstanding			536,000.00
Capital liabilities			
7% cumulative preferred stock outstanding		$2,629,566.67	
Class "A" common stocck, 129,765 1/6 shares	$1,433,989.77		
Subscriptions for 3300 shares	33,000.00	1,466,989.77	
Class "B" common stock, 15,000 shares		15,000.00	
Net surplus through appreciation		1,844,920.70	5,956,477.14
			$6,708,074.67

Note: The accumulated dividend on preferred stock at December 31, 1931, amounted to $557,783.39. It was reported that the company had no contingent liabilities.

The accompanying balance sheet shows current assets of $1,089,264.94, which includes $439,076.79 in cash and government securities, and against which there were current liabilities of $95,005.08. The company has no bank loans or past due obligations. Ratio of current assets to current liabilities is better than 11 to 1.

In addition to disbursement of $143,786.10 in dividends to preferred stockholders, $175,-309.99 was used for plant additions, reduction in farm mortgages and long term contracts, and for the retirement of the company's own bonds purchased on the market. After these expenditures, working capital was increased $63,656.10 as a result of 1931 operations.

Reductions were made during the year in such fixed charges as interest, taxes and insurance. In addition to substantial reduction in wages, salaries and personnel, manufacturing costs have been lowered through installation of labor-saving machinery and standardization of processes. With these plant economies and reduction in overhead expense, the company is now in a position to show earnings on considerably smaller annual sales.

Competitive conditions resulted in low prices in both the lime and insulation board industries, but since the bulk of the business was in gypsum, this has not greatly affected earnings. There has been a recent tendency toward lower prices on certain gypsum products, but it is too early to forecast the effect of this on 1932 income.

Consistent research has enabled the company to broaden its line of products each year, until in 1931 thirty items were marketed, all sold under the "Gold Bond" trade name and to the building construction field. This diversity permits competition in three major industries—gypsum, lime and insulation. Further developments during the current year are expected.

STATEMENT OF INCOME OF NATIONAL GYPSUM CO. AND SUBSIDIARY
(Year ended December 31, 1931)

	1931	1930
Earnings from operations before bond interest, depreciation and depletion	$434,697.29	$360,619.72
Depreciation and depletion	124,328.87	128,387.42
Income before interest on bonds	$310,368.42	$232,232.30
Deduct interest on bonds	33,377.59	38,168.89
Net income from operations	$276,990.83	$194,063.41
Deduct extraordinary charges	none	142,099.25
Net profit for the year	$276,990.83	$ 51,964.16

Note: The statutory loss for prior years, allowable under the provisions of the federal income tax act, exceeds the taxable income for 1931. Therefore there is no federal tax liability.

Recent Dividends Announced

Alpha P. C. com. (qu.)	0.25,	Apr. 25
Arundel Corp. com. (qu.)	0.75,	Apr. 1
Calaveras Cement pfd. (qu.)	1.75,	Apr. 15
Dufferin Pav. and Crushed Stone pfd. (qu.)	1.75,	Apr. 1
Ideal Cement com. (qu.)	0.50,	Apr. 1
New York Trap Rock 7% pfd. (qu.)	1.75,	Apr. 1
Santa Cruz P. C. com. (qu.)	1.00,	Apr. 1
Superior P. C. Cl. B	0.12½,	Mar. 21
Superior P. C. Cl. A. (mo.)	0.27½,	Apr. 1
Johns-Manville Corp. pfd. (qu.)	1.75,	Apr. 1

Materials Service Corp.

THE Material Service Corp., Chicago, Ill., sand, gravel and crushed stone producer, reports net income for 1931 of $302,081, equal to $2.41 a share on the capital stock comparing with net of $265,040 or $2.12 a share in 1930.

Cash is shown about $70,000 smaller than in 1930 and marketable securities are less by approximately $22,000, all of which was more than offset by a reduction in bank loans to $95,000 from $335,000. Earned surplus was reduced to $1,407,364 from $1,511,543 at the end of 1930.

"None of the profits realized from the sale or collections during the year of fixed assets sold is reflected in the net profits reported," Henry Crown, president, says in remarks to the stockholders in the 1931 report.

A detailed comparison of the financial statement follows:

CONSOLIDATED BALANCE SHEET OF THE MATERIALS SERVICE CORP.

ASSETS

	(As of December 31) 1931	1930
Current assets:		
Cash	$ 34,587	$ 104,757
Marketable securities (cost)	107,135	129,254
Accounts receivable	815,268	1,215,548
Inventories	264,312	365,403
Cash value insurance	16,554	.....
Balance to be liquidated	257,058	400,407
Total current assets	$1,494,914	$2,215,369
Prepayments	6,870	7,500
Investment (cost)	*	133,527
Deferred charges	.....	230,000
Fixed assets	2,544,230	2,689,483
Other assets	775,315	249,624
Good will	1	1
Total assets	$4,821,330	$5,525,505

LIABILITIES

Current liabilities:		
Bank loans	$ 95,000	$ 335,000
Notes due	.....	117,500
Accounts payable	419,654	735,185
Accruals	94,449	124,700
Total current liabilities	$ 609,103	$1,312,385
Purchase money obligations	39,500	45,460
Funded debt	341,333	341,333
Note due 1933	100,000	.....
Minority interest	25,000	25,000
Capital stock	1,250,000	1,250,000
Capital surplus	1,049,029	1,039,784
Earned surplus	1,407,364	1,511,543
Total liabilities	$4,821,330	$5,525,505

*Included in other assets in 1931.

Builds Own Bag Plant

THE United States Gypsum Co. has erected a new building at Genoa, Ohio, for the manufacture of paper bags used in the sale of lime. The capacity will be a million and a half sacks monthly.—*Toledo (Ohio) Blee.*

Government Aid Asked to Finance City Construction

REDUCED PUBLIC CONSTRUCTION by municipalities and consequent unemployment makes it obligatory upon the federal government to extend credit facilities to American cities with a view to stimulation of public works to provide employment, it was declared March 11 at a hearing before a subcommittee of the Senate committee on education and labor.

"Under measures so far taken by the government the railroads have been helped, and, through the banks, industry has been helped," F. E. Schmitt, New York City, editor of the *Engineering News-Record*, told the committee. "Nothing has been done for the cities, however, although they are far more intimately related to the problem of maintaining and improving the economic balance."

"Many of the cities of the first class are in need of funds for much needed public improvement," John Sloan, of Sloan and Robertson, architects, New York City, stated, "and while their credit is entirely sound, they hesitate to issue bonds for public sale for fear of an uncertain market."

This testimony was given in connection with the La Follette bill (S. 2419) to create an administration of public works, expand the public works program and provide a bond issue of $5,500,000,000.

"During the closing months of 1931 public construction projects were checked by the collapse of the bond market, which made it difficult or impossible for cities, counties, and in some cases states, to finance their projects by selling bonds," Mr. Schmitt testified. "A cost of hundreds of millions of dollars was involved in the decline of public works, in fact, conservative estimates go well beyond half a billion."

"The total of retrenchment by cities since the first of the year is mounting rapidly, and may reach a billion dollars, most of which would have been 1932 expenditures," continued Mr. Schmitt. "Translated into jobs the aggregate decreases of public construction will mean about a million men unemployed, which would increase our present unemployment something like 10%.

"Nothing is now in sight in the way of increased employment by private industry to make up for the very great and sudden increase in the number of idle. It would be difficult to multiply federal work on short notice sufficiently to make up for any large reduction in state and municipal work.

"Thus it is apparent that the real opportunity for public work is in the domain of state, municipal and other local governments, not in federal construction.

"Under measures so far taken by the government the railroads have been helped and (through the banks) industry has been helped. Nothing has been done for the cities, however, although they are far more intimately related to the problem of maintaining and improving the economic famine.

"Provision for assistance to local governments is included in the bill under consideration. This is a vital emergency provision, but because of the way in which this aid is extended as well as because of other features of the bill, I believe at the present moment more effective aid could be given through a semi-public corporation which would provide a market for municipal securities."

Increased Federal Taxes in Prospect

IT IS PRESUMED every rock products producer reads the newspapers and is aware that Congress is setting the stage for making him contribute to "balancing the budget." The matter of most importance to him, of course, is the proposed manufacturers' sales tax on all commodities with certain exceptions, largely agricultural products or materials used in agriculture.

Obviously, the administration of such a tax law in the rock products industries, where the purchaser in many instances is another public authority or government, not taxable by the federal government, is going to be very complicated. There will be numerous inequities to be ironed out—the cases of the contractor who produces his own aggregates, the side-of-the-road operation which produces less than $20,000 worth of material annually (exempt, according to the proposed law), the manufacturer of ready-mix concrete who would pay more than the contractor who mixes his materials on the job, etc., etc.

V. P. Ahearn, executive secretary of the National Sand and Gravel and the National Ready-Mixed Concrete Associations, has kept the members well informed on these developments, and has urged that they take an active interest. Mr. Ahearn seems quite sure that the sales tax will become law, and most observers close to affairs at Washington seem to share that belief.

Opinion within the rock products industry, as in every other industry, is divided on the subject of the sales tax. Almost any tax is a nuisance, of course; but those who believe the national budget should be balanced as soon as possible realize that the money must come from somewhere, and they also realize they must contribute their share. There is no organized or even crystallized opposition to the sales tax in the rock products industry, so far as we know.

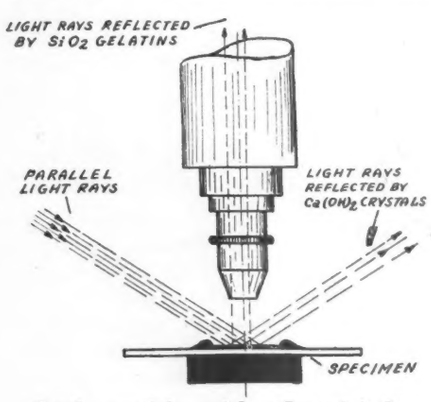
Crushed Stone Plant Makes Sidewalk Mixture

PRE-MIXED asphaltic concrete of the cold-lay type, as manufactured by W. F. Culbert and Sons, Marion, Va., in addition to having many uses as a paving and patching material, is utilized also for sidewalks, a recent article in the *Manufacturers Record* states. A plant of considerable size is operated to manufacture this paving material.

Foreign Abstracts and Patent Review

Hardening of Portland Cement. F. F. Tippmann groups the existing theories which seek to explain the hardening process of portland cement as follows: the crystallization theory as represented by Le Chatelier and others; the colloid (gel) theory of Michaelis, whose principal representatives are today, in a broader sense, Kuehl, P. H. Bates, A. Hauenschild and others; and the crystalloid-colloid theory, which is defended by Keisermann, Blumenthal, Scheidler, and recently by Biehl, H. W. Gonell and others. In all these theories very little consideration is given to the hydrate of lime which is liberated in the hydration of cement; it is regarded as an immaterial and, under certain conditions, detrimental attendant phenomenon which is denied a definite part in the hardening; in reference to the quantity of the actually liberated hydrate of lime the views are also quite different. A criticism is given of the views of Kuehl in connection with the results of Tippmann's researches on the hardening problem.

Tippmann employed a very simple microscopic method for studying the setting and hardening process of cement mortars having a normal admixture of water. This method permits not only a direct observation of the crystalline hydrate of lime, but shows also that all hydrolytically separated hydrate of lime is removed in the crystal form. The mortar is placed on a slide, spread thinly with the cover glass, and the rim of the cover glass sealed at once with paraffin. The surface of the specimens is observed in a beam of light falling on the object at an angle as shown. The specimen may therefore be of any desired thickness; but if the cement is screened on the 4900 or 10,000 metric mesh screen, the specimen can be made thin enough so that it can be observed in transmitted instead of deflected light. If the projected light rays fall upon crystal surfaces, they are reflected so that the crystals appear dark, while colloidal formations appear light. A larger magnification than 205 cannot be obtained with this method, since the specimens must be kept at a certain distance from the objective. There is some difficulty in obtaining good microscopic photographs of the specimens; but a number of them are shown by the author. The complete results of Tippmann's researches are to be published at an early date. He has arrived at the following conclusions:



Study particles with reflected light

1. The hydrolysis of the lime silicate of the clinker is complete when treating with water, that is, the cleavage products consist of silicic acid gelatins and hydrate of lime. It is immaterial whether much or little is used, in relation to the cement substance.

2. When a normal amount of water is used in the cement mortar, the products of hydration are wholly different, in relation to form and kind due to the high viscosity of the system, in comparison to when there is a great excess of water; and they assume somatoidal forms.

3. The needle crystals appearing in cement preparations treated with excess of water consist of hydrate of lime and do not form when the mortar consistency is normal.

4. Calcium hydro-silicates do not form in the hardening cement, either in crystalline or in colloidal form.

5. All hydrolytically separated hydrate of lime in the hardening cement mortar is present in the crystalline modification. The crystal form of the hydrate of lime in the hardened cement is not the hexagonal plate or column form appearing at other times in watery cement preparations, but an irregular serviceable space-filling lamella form.

6. Crystalline hydrate of lime, that is, hydrate of lime which is capable of crystallization, can not be considered as cause of the lime action. Hydrolytically separated hydrate of lime is always capable of crystallization, and without a catalyst; amorphous hydrate of lime requires a catalyst for crystallization, is therefore to be claimed as cause of lime action and forms only in the later hardening stage in the hydration of cements which contain free lime. In this stage the present catalyst of crystallization, namely gypsum, no longer has effect.

7. The hardening process of portland cement is based upon an ideal combination of the colloidal silicic acids and of the crystalline hydrate of lime which forms the greatest and most important constituent of the hardened portland cement. The hydrate of lime is considered as foundation of the cementing property of the cement, therefore as carrier of the hardening.

8. The gypsum action is based upon excessive crystallization of the hydrate of lime, whereby the available quantity of silicic acid gelatins is not sufficient. On the other hand, it is possible to make a "lime action" sound by addition of gypsum or by transfer of the amorphous hydrate of lime into the crystalline modification. This, however, is practical only to a limited extent, since too much crystalline hydrate of lime may be formed.—*Zement* (1930) **19**, 52, pp. 1225-1234.

Physical - Chemical Characteristics of Cement. D. Werner and Stig Giertz-Hestroem, Stockholm, report on the dependence of the technically important characteristics of concrete on the physical-chemical characteristics of cement. The results show that the characteristics essential for technique, namely, compressive strength, tensile strength, modulus of elasticity, shrinkage, and water permeability, are conditioned primarily by the degree and kind of water combination in the system; whereas, for example, the chemical composition of the cement material outside of that seems to be of subordinate importance in this connection. The authors describe also the apparatus for measuring elasticity, for determining shrinkage, for determining water permeability, and the method of their use, also the detailed results of their investigations. Further work is planned to increase the usability and the technical value of cement by way of differentiating its characteristics.

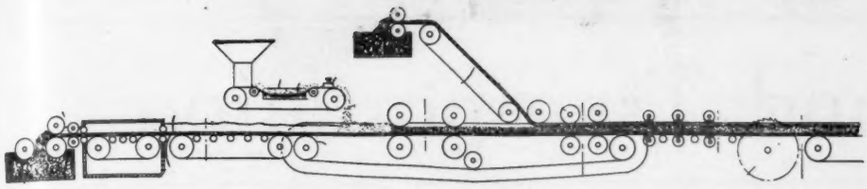
The test results show that empirical relations can be found between all investigated technical characteristics and the various water-combining characteristics, relations which appear to be independent of such characteristics of cement, as chemical composition, age and water content. Formulas have been worked out by the authors; and they found that the calculated and the determined figures agreed.—*Zement* (1931) **20**, 46, pp. 984-987; **47**, pp. 1000-1006.

Asbestos and Its Applications. J. Prouteau gives essential information on asbestos, asbestos-cement, asbestos-cement products and their manufacture and use—including flat plates, slates, corrugated plates, large-corrugation plates, piping for drainage and other uses and molded pieces of various sizes and shapes.—*Revue des Materiaux de Construction et de Travaux Publics* (1931) 259, pp. 156-159.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Commissioner of Patents, Washington, D. C., for each patent desired.

Plaster Board. The author of this patent proposes to combine paper making and gypsum wallboard manufacture into one con-



Combines paper making and gypsum wallboard manufacture in one operation

tinuous process. The initial step in the process is the formation of the lower cover sheet, using various paper-forming pulps. The pulp is fed to a wire or belt and is drawn through a series of rolls and passes through a drying box, after which the gypsum core-forming material is poured on top of the sheet. Later in the process the top cover sheet is fabricated on the gypsum core, thus combining paper making with gypsum wallboard manufacture. *Harry C. Raynes, assignor to Bemis Industries, U. S. Patent No.* 1,774,813.

Process for Treatment of Dolomite and Other Magnesium Carbonates. The process consists in first calcining the dolomite, then subjecting the calcines to a fractional chloridizing. The calcium is removed as calcium chloride in the first period and the magnesium is removed as magnesium chloride in the second period. Silica and other impurities are left behind as an insoluble residue. The series of operations preferably takes place in a closed cycle. The roasted dolomite is treated with a solution of ammonium chloride of such strength that there is only enough chlorine to combine with the lime. This solution is removed and filtered and added to a stock $CaCl_2$ solution. The residue is then treated with hydrochloric acid of such strength that only the magnesium compounds will be affected. The ammonia released by treating the dolomite with ammonium chloride is added to the calcium chloride solution with CO_2 gas from the kiln, and this brings down calcium carbonate and forms ammonium chloride which may be used again. The magnesium chloride is crystallized and electrolyzed, producing magnesium and chlorine which may be converted into hydrochloric acid for reuse.—*Joseph Blumenfeld, Assignor to Societe de Produits Chemiques des Terres Rares, Paris, France, U. S. Patent* 1,778,659.

Bentonite as a Pozzolanic Material. The author of this patent, in a previous patent (No. 1,601,295, granted September 26, 1926) added bentonite as near its natural form as possible to concrete mixes, so that when hydration started the bentonite would swell and close the pores in the concrete, rendering it more waterproof. The present invention describes the use of bentonite to which a small amount of sodium chloride has been added as a pozzolanic material. He indicates that if bentonite is added to concrete without the sodium chloride, no beneficial results are noticeable, but that when 5 to 10% of the treated bentonite is added to concrete the ageing rate of concrete is accelerated with increases in final strengths of the concrete.

The following results are given by the author to substantiate his claims:

TENSILE STRENGTHS OF VARIOUS CEMENTS—(lb. per. sq. in.)

	(1-3 sand briquets)			
	Natural cement	Plain portland cement	High alumina cement	This invention
24 hours	0	0	330	464
7 days	120	250	430	537
28 days	180	400	538	561

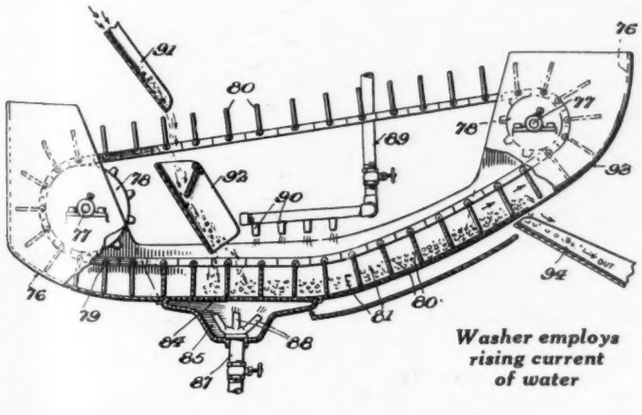
COMPRESSIVE STRENGTHS OF VARIOUS CEMENTS—(lb. per. sq. in.)

	(1-3 sand cylinders)			
	Natural cement	Plain portland cement	High alumina cement	This invention
24 hours	0	0	4725	3755
3 days	400	2500	4985	9891
28 days	1800	4500	5004	12212
	(1-2-4 concrete)			
24 hours	0	400	2865	2130
3 days	250	1200	3542	3457
28 days	1500	3800	3891	5690
Fineness passing 200-mesh	95%	85%	97.6%	95%

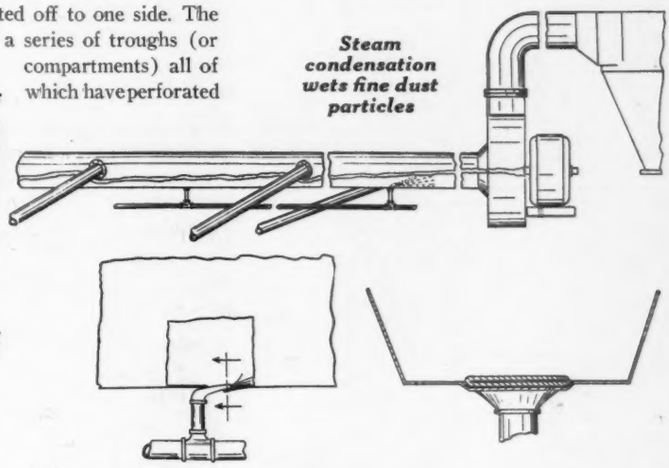
—*William A. Collings, assignor to the Silica Products Co., U. S. Patent No.* 1,755,502.

Method and Apparatus for Cleaning Gravel or the Like. The method patented is that of admitting a rising current of water under the gravel to lift out the trash and dirt. This is floated off to one side. The apparatus consists of a series of troughs (or compartments) all of which have perforated bottoms to admit the rising water and open ends through which the water and trash go to waste. There are several forms of apparatus shown in the specifications. The preferred form is a series of troughs which are carried by moving chains, but another resembles an ordinary cylindrical washer except that it is divided into several compartments by radial partitions. Still another form has partitions like the flights of a screw. The form that is shown here is the simplest mechanically and illustrates the principle as well as any of them. The gravel is fed by two chutes (91 and 92) into troughs made by the flights of a flight conveyor which moves over a perforated bottom. Water from jets (88) rises through the perforations while the flights drag the material over a water box. Then they drag it over perforations through which the water drains away. The water flows out at the ends of the troughs into waste chutes which are not shown. If more water than is supplied by the jets is needed it is admitted through other jets above (90). The drained gravel is discharged through the chute shown. The claims cover the process of dividing the gravel or crushed stone into small batches, maintaining them in a settled and unagitated condition and causing water to flow upwardly through each batch of gravel.—*Guy B. Bebout, U. S. Patent* 1,812,280.

Dust Collecting. The device shown uses suction from a fan combined with steam blown into the trunk pipe that carries the dust laden air to the fan. The steam jets are set so that the steam impels the dust toward the fan. Condensation of the steam wets the fine particles and makes them easier to save in the cyclone separator that follows the fan. The inventor claims that the fan does not have to move so much air to do the same amount of work and also that the lightest particles can be saved in an ordinary separator because of their being wet. He mentions that the device is especially effective in collecting the fine dust from kiln dried lumber. *G. L. Jackson, assignor to Kirk and Blum Manufacturing Co., U. S. Patent No.* 1,792,587.



Washer employs rising current of water



Steam condensation wets fine dust particles

Traffic and Transportation

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week ending March 19:

TRUNK LINE ASSOCIATION DOCKET

28808. (A) **Sand, building,** carloads; (B) **sand, engine, blast, glass, molding, and ground flint,** carloads (See Note 2), to Utica, N. Y., from Hancock, Berkeley Springs, W. Va., (A) $2.70, (B) $3.10 per net ton, and from Triplett-Gore, Va., (B) $3.10 per net ton. Reason—Proposed rates are comparable with rates to Solvay, N. Y.

28809. **Sand, building and engine,** in open top equipment, carloads (See Note 2), from Hancock, Berkeley Springs and Great Cacapon, W. Va., to Milesville, Penn., $1.80 per net ton. Present rate, $1.95 (See Note 5).

28811. **Crushed stone,** carloads (See Note 2), from White Haven, Penn., to Quakake, Mahanoy City, Penn., 80c, and Ashland, Penn., 90c per net ton. (See Note 5.)

M-2049. **Crushed stone and screenings,** carloads, from Naginey, Penn., to Reedville, Penn., $16 per car, subject to emergency charge, rate to expire December 31, 1932. Note—To apply only on traffic moving to points on the Kishacoquillas Valley R. R. (See Note 4.)

28814. To cancel rate of $2.75 per net ton on **glass sand,** carloads, from Hancock, Berkeley Springs and Great Cacapon, W. Va., to Bradford, Penn., class rates to apply. Reason—Investigation develops there has been no movement for some time and no prospect of future movement, therefore rate is obsolete.

28815. **Common sand,** carloads (See Note 2). from Philadelphia, Penn., to Barto, Penn., $1 per net ton. Present rate, $1.15. (See Note 5.)

28818. **Gravel and sand** (other than blast, engine, fire, glass, molding or foundry quartz, silex and silica), carloads (See Note 2), from Baltimore, Md., to Greenmount and Westminster, Md., 80c per net ton. (See Note 5.)

28828. Change the description of **furnace limestone,** carloads, when loaded in bulk in open top equipment, to read: "Crude limestone, when loaded in bulk in open top equipment," on traffic from Engle and Martinsburg, W. Va., to Piedmont, W. Va., and Luke, Md., as published in B. & O. R. R., I. C. C. No. 22120. No change in rates. Reason—Investigation develops that there is no movement of furnace limestone, while there is a movement of crude limestone between the above points.

28837. **Slag,** carloads (See Note 2), from Palmerton, Penn., to L. V. R. R. stations, Jersey City Terminal, N. J., Newark, Cranford, Metuchen, Perth Amboy (New Brunswick Ave.), Manville, Flemington, Phillipsburg, N. J., Easton, Tatamy, Freemansburg, Allentown, Catasauqua, Slatington, Lehigh Gap, Pottsville (12th St.), Lehighton, Quakake, Sandy Run, Deringer, Hazleton, Shenandoah, White Haven, Avoca, Wilkes-Barre, Pittston, Forest Castle, Luzerne, Penn., and various. Rates ranging from 80c to 140c per net ton. Reason—Proposed rates are fairly comparable with rate from Hokendauqua, Penn.

28840. **Glass sand,** carloads (See Note 2), from Triplett-Gore, Va., to Weston and Buckhannon, W. Va., $2.25 per net ton. (Present rate, $2.30 per net ton.) Reason—Proposed rate is fairly comparable with rates from Berkeley Springs, W. Va.

28856. To establish specific rates on **crushed stone, crushed stone screenings,** in open top equipment, carloads, from Casparis, Penn., Dunbar, Penn., Connellsville, Bluestone Co., Penn., to destination within a radius of 200 mi. in the states of Pennsylvania (located east of line drawn north and south of Sand Patch), Maryland, West Virginia and Virginia, which will be based on the following mileage scale of rates (rates in cents per 2000 lb.):

15 miles and under	60	80 to 100 miles	110
15 to 25 miles	70	100 to 125 miles	120
25 to 40 miles	80	125 to 150 miles	130
40 to 60 miles	90	150 to 175 miles	140
60 to 80 miles	100	175 to 200 miles	150

Destinations on South Branch of B. & O. R. R. located south of Green Spring, W. Va., 10c per 2000 lb. additional; destinations located on connecting lines, 20c per 2000 lb. additional. (See Notes 3 and 4.)

28662. **Crushed stone,** carloads (See Note 2), from White Haven, Penn., to Water Gap, Stroudsburg or East Stroudsburg, Analomink and Henryville, Penn., $1.30, and Mt. Pocono and Pocono Summit, Penn., $1.20 per net ton.

28867. **Limestone, unburned, ground,** carloads, minimum weight 50,000 lb., from Rosendale, N.Y., to Goshen, Middletown, Circleville, Bullville and Pine Bush, N. Y., $1.40 per net ton. Reason—Proposed rate is comparable with rates from Lime Crest, N. J.

28868. **Sand** (other than blast, engine, foundry, glass, molding or silica) and **gravel,** carloads (See Note 2), from Georgetown (West Washington), D. C., to (Winchester & Wardensville R. R.) Hill Crest to Hogue Creek, Va., $1.30; Gainesboro to Larrick, Va., and Shiloh, Va., to Capon Springs, W. Va., $1.40; Riverside to Wardensville, W. Va., $1.50, being proposed rates in cents per net ton. Reason—Proposed rates are comparable with rates to Riverton, Front Royal, Va., and Keifer, Md.

CENTRAL FREIGHT ASSOCIATION DOCKET

30767. To establish on **sand, viz., blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica,** carloads, from Delhi, O., to Cambridge City, Ind., rate of 151c per net ton. Present, 189c.

30768. To establish on **quarry waste,** carloads, minimum weight 120,000 lb., from Sibley, Mich., to Detroit, Mich., rate of 35c per net ton. Present rate, 40c.

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

Note 4—Reason—To meet motor truck competition.

Note 5—Reason—Proposed rates are comparable with rates on like commodities for like distances, services and conditions.

30775. To establish on **stone, crushed** (in bulk), **crushed stone screenings** (in bulk), and **limestone, agricultural, unburned** (not ground or pulverized), in bulk, in open top cars, carloads, from Genoa and Martin, O., to destinations in Michigan (representative points shown in Exhibit A), rates as shown in Exhibit A attached. Present, sixth class per official classification.

EXHIBIT A

To (representative) N. Y. C. R. R. stations:

	Prop.		Prop.
Adrian	80	Moscow	100
Clayton	90	Knorr Lake	95
Pittsford	95	Addison Jct.	95
Hillsdale	100	Onsted	90
Coldwater	105	Ridgeway	85
Sturgis	115	Rea	90
White Pigeon	125	Montgomery	105
Schoolcraft	135	Mosherville	100
Kalamazoo	135	Brooklyn	95
Otsego	145	Pittsfield Jct.	100
Allegan	145	Hogan	90
Hopkins	155	Napoleon	95
Byron Center	155	Morenci	90
Findley	125	Stony Creek	80
Albion	105	Trenton	85
Devereaux	115	Wyandotte	90
Charlesworth	115	Detroit	95
Kingsland	125		

30778. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel** (except as indicated below, carloads (See Note 3.). From Fairview and Swanville, Penn.

To	Pres. basic rate	Prop. basic rate
Erie, Penn.	*50	*45
Swanville, Penn.	†50	†45
Conneaut, O.	‡60	‡59
Ashtabula, O.	‡65	‡59

*Applies when for delivery on tracks of N. Y. C. & St. L. R. R. only.

†Applies only from Fairview, Penn.

‡Applies only on sand as described above.

Present and proposed rates subject to emergency charges.

Route: Via N. Y. C. & St. L. R. R.

Expiration date: Proposed rates to expire March 31, 1932, and present rates to be restored effective on that date.

30800. To establish on **crushed stone,** in bulk, in open top cars only; **limestone, agricultural** (not ground or pulverized), **or limestone, agricultural, unburned,** in bulk, in open top cars only, carloads, from Thornton, Ill. Rates in cents per ton of 2000 lb.

Crushed Stone, in bulk, in open top cars only

Index No.		Present Via C.&E.I.Ry.	Proposed Via C.&E.I.Ry.
	B. & O. R. R.		
145	Gary, Ind.	76	70
150	Miller (Lake Co.), Ind.	76	70
	C.&E.R.R. (Erie S.)		
790	Hammond, Ind.	75	70
795	Saxony, Ind.	75	70
800	Highlands, Ind.	76	70
	Wabash Ry.		
5254	Tolleston, Ind.	76	70

Limestone, Agricultural, in bulk, in open top cars only

Index No.		Present Via C.&E.I.Ry.	Proposed Via C.&E.I.Ry.
	B. & O. R. R.		
145	Gary, Ind.	76	70
150	Miller (Lake Co.), Ind.	76	70
220	Napanee, Ind.	120	113
223	Gravelton, Ind.	120	113
225	Milford Jct., Ind.	120	113
228	Leeland, Ind.	120	113
230	Syracuse, Ind.	120	113
235	Wawasee, Ind.	120	113
236	Cromwell, Ind.	120	113
237	Kimmell, Ind.	120	113
240	Albion, Ind.	120	113
	C.&E.R.R. (Erie S.)		
790	Hammond, Ind.	75	70
795	Saxony, Ind.	75	70
800	Highlands, Ind.	76	70
810	Winfield, Ind.	92	77
815	Palmer, Ind.	92	77
820	Hurlburt, Ind.	92	77
825	Boone Grove, Ind.	92	77
830	Kouts, Ind.	95	77
835	Clanricarde, Ind.	95	85
840	Wilders, Ind.	100	85
855	North Judson, Ind.	100	85

30801. To establish on **sand and gravel,** carloads, from Gosport, Ind., to Centerpoint, Ind., rate of 95c per net ton, subject to increase under tariff of emergency charges. Present rate, 12c (classification basis).

30802. To establish on **crushed stone,** in bulk only; **crushed stone screenings,** in bulk only; **tailings,** in bulk only; **agricultural limestone, unburned** (not ground or pulverized), in bulk in open top cars only, carloads, from Narlo, O., to N. Y. C. stations, Simons, 135c, and Coalburg, O., 145c per net ton via N. Y. C. & St. L. R. R., Ashtabula, O., and N. Y. C. R. R. and C. & O. Ry. station, Haydenville, O., 135c per net ton, via N. Y. C. & St. L. R. R., Fostoria, O., and C. & O. Ry. Present: 140c to Simons and 160c per net ton to Coalburg, O., and sixth class rate to Haydenville, Ohio.

30804. To establish on **foundry or fluxing stone,** carloads, from Quarry, Mich., to Saginaw, Mich., rate of 60c per net ton, subject to the tariff covering emergency charges. Present, 75c per net ton.

30805. To establish on **crushed stone,** in bulk only; **crushed stone screenings,** in bulk only; **tailings,** in bulk only; **agricultural limestone, unburned** (not ground or pulverized), in bulk in open top cars only carloads, from Narlo, O., to Chicago, Ill., rate of 160c per net ton. Present, 460c per net ton.

30808. To establish on **sand and gravel,** carloads, in open top cars, from Ft. Jefferson, O., to Houston, O., rate of 45½c per net ton, emergency increase in addition, to expire November 30, 1932. Present, 60c per net ton, emergency increase in addition.

30618. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica), and **gravel,** carloads, from Leeland, Ind., to Bremen, La Paz, Teegarden, 50c; Union Centre, 55c; Wellsboro, Ind., 60c per net ton, to meet truck competition, emergency charge in addition to rates proposed. Rates will carry an expiration date of December 31, 1932. Present, 60c to Bremen; 65c, La Paz; 69c, Teegarden, Union Centre; 75c per net ton, Wellsboro, Ind.

30833. To establish on **fluxing stone,** carloads,

from East Fultonham, O., to Barberton, O., rate of 92c per gross ton. Present, 100c per gross ton. Above rates do not include emergency charge.

30819. To establish on **crushed stone**, in open top cars, from Greencastle, Ind., to Petersburg, Ind., rate of 90c per net ton, to expire November 1, 1932. Emergency increase in addition. Present, 103c per net ton, emergency increase in addition.

30820. To establish on **crushed stone**, in open top cars, carloads, from McVittys, O., to Chagrin Falls, O., rate of 100c per net ton. Emergency increase in addition. Present, 18c.

30831. To establish on **crushed stone**, in open top cars, carloads, from Lewisburg, O., to Coldwater, St. Henry, New Weston and Rossburg, O., rate of 50c per net ton, to expire December 31, 1932. Emergency increase in addition. Present, 60c. Emergency increase in addition.

30840. To establish on (a) **stone, crushed**, also **agricultural limestone**, in bulk, in open top cars, and (b) **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel**, carloads, from Keeport, Ind., to Claypool (a) 90c; to Urbana, Bolivar, North Manchester, Rose Hill, Silver Lake, Ind., 85c; from Huntington, Ind., to Claypool and Silver Lake, Ind., 85c; from Wolcottville, Ind., to Claypool, Ind., (b) 90c per net ton. Present—(a) From Keeport, Ind., to Claypool, Ind., 127c; to Urbana, 92c; Bolivar, North Manchester, Rose Hill, Silver Lake, 104c; from Huntington, Ind., to Claypool, 127c per net ton; to Silver Lake, Ind., class. (b) From Wolcottville, Ind., to Claypool, Ind., class. Routes—(a) Via Wabash Ry., Wabash, Ind., C. C. C. & St. L. Ry. (b) Via Wabash Ry., New Paris, Ind., C. C. C. & St. L. Ry.

30841. To establish on **sand and gravel**, carloads, from Gosport, Ind., to Winslow, 115c, and to Boonville, Ind., 120c per net ton, subject to emergency charge. Present, 16c to Winslow and 17c to Boonville, Ind.

30843. To establish on **crushed stone**, carloads, from Putnamville, Ind., to Solsberry, Ind., rate of 95c per net ton, subject to the tariff of emergency charges. Present, 105c per net ton.

30844. To establish on **crushed stone**, in open top cars, carloads, from McVittys, O., to Neffs, O., rate of 155c per net ton. Present, 20c ($4 per net ton).

30863. To establish on **stone, crushed** (in bulk), **crushed stone screenings** (in bulk), **agricultural limestone** (not ground or pulverized, in bulk in open top cars only), and **agricultural limestone screenings**, carloads, from Bellevue, O., to Norfolk and Collins, O., rate of 50c per net ton, emergency charge to be in addition to proposed figures. Present, 60c per net ton.

30868. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel** (except as noted), carloads, from Columbus, O., to Carey, O., rate of 80c per net ton via N. Y. C. R. R. (W), Kenton, O., C. C. C. & St. L. Ry. Present, 280c.

30885. To establish on **stone, crushed** (in bulk), **limestone, agricultural** (not ground or pulverized), (in bulk, in open top cars), and **limestone, unburned, agricultural** (in bulk in open top cars), carloads, from East Liberty, O., to Lathrop, O., rate of 120c per net ton. Present, 125c.

30889. To establish on **limestone, agricultural** (not ground or pulverized), **screenings, crushed stone, stone, crushed**, in bulk in open top cars, carloads, from Maple Grove, Gibsonburg and Woodville, O., to Spartansburg, Glynden, Centerville, Tryonville, Hydetown, Titusville and Rouseville, Penn., rate of 190c per net ton. Present, classification basis.

WESTERN TRUNK LINE DOCKET

7833. Rates—Mixed carloads—**Limestone, ground** and **raw mix** in mixed carloads with cement, from Portland, Colo., to points in W. T. L. territory. Rates: Present—No provision for mixed carload shipments. Proposed — Publish provision that rates on cement will also apply on ground limestone and raw mix in sacks or barrels, when shipped in mixed carloads with cement.

6025-F. **Limestone, crushed or ground**, carloads, from Valmeyer, Ill., to representative points in Kansas as shown below. Present rates, class and combination. Proposed (representative points):

To	80% of first class	Prop.
Kanorado, Kan.	20	20
Cedarvale, Kan.	15	15
Burr Oak, Kan.	17	17
Arcadia, Kan.	13	13

Minimum weight: Present—various. Proposed—(See Note 3.)

(Complete copy of exhibit will be furnished on request.)

6979-A. **Sand, silica, pumice**, and **ash, volcanic** (See Note 1), but not less than 60,000 lb., except where car of less than 60,000 lb. capacity is furnished at carrier's convenience the marked capacity of car will apply, from Eustis, Neb., to Chicago, Ill. Present rate, 24c per 100 lb. per Item 3085B of C. B. & Q. R. R. Tariff G. F. O. No. 5000C, I. C. C. No. 17177; proposed, 23½c.

ILLINOIS FREIGHT ASSOCIATION DOCKET

6529. **Crushed stone**, in open top cars only, carloads (See Note 3), from Dalton, Ill., to Penn. R. R. stations in Illinois. Rates in cents per net ton. To representative points.

	Pres.	Prop.		Pres.	Prop.
Collinsville	101	80	Teutopolis	.....	110
Troy	113	98	Dexter	126	105
Smithboro	126	98	Farrington	.....	121

6533. **Lake sand**, ex lake, from McCormick Dock, Ill., to St. Louis, Mo. Present, 23c per 100 lb., minimum weight 40,000 lb. Proposed—139c per net ton proportional, ex lake (See Note 3), but in no case will the minimum weight be less than 60,000 lb.

6535. **Stone (sand), crushed, ground or pulverized**, carloads (See Note 1), from Ottawa, Ill., to East St. Louis, Ill. Present, $1.64 per net ton; proposed, $1.39.

I. C. C. Decisions

20039. Agricultural Limestone. Examiner H. W. Archer, on further hearing in 20039, National Mortar & Supply Co. vs. Ann Arbor et al., has recommended that the Interstate Commerce Commission find unreasonable the rates on agricultural limestone, in bulk or in bags in box cars, and in bulk in open top cars, from Gibsonburg, O., to destinations in Michigan, award reparation and prescribe rates for the future. The previous report in this case was in 152 I. C. C. 429.

For the removal of the unreasonableness and undue prejudice Examiner Archer recommended scales for application to agricultural limestone in box cars and for that commodity in open top cars. The scale for box car transportation, minimum 80,000 lb., subject to marked capacity if less but in no case less than 60,000 lb., begins with a rate of 100c a ton for 40 mi. and under, becomes 130c for the block between 80 and 100 mi.; 170c for the block between 175 and 200 mi.; 210c for the block between 275 and 300 mi.; and ends with a rate of 230c for the block between 325 and 350 mi.

The scale for open top transportation, minimum weight 90% of the marked capacity of the car, subject to actual weight when loaded to full visible capacity, begins with a rate of 70c for 40 mi. and under, becomes 100c for the block between 80 and 100 mi.; 140c for the block between 175 and 200 mi.; 180c for the block between 275 and 300 mi.; and ends with a rate of 200c for the block between 325 and 350 mi.

Ask Extension of Reduced Sand and Gravel Rate

AN EXTENSION for one year of the reduced rates under which they are now hauling sand, gravel and crushed stone in Wisconsin was to be asked of the Public Service Commission by the Chicago and North-Western railroad and the Chicago, Milwaukee and St. Paul railroad.

For the past 12 months the two railroads have been hauling sand, gravel and crushed stone from all parts of Wisconsin, to Milwaukee, at a rate 25% lower than the regular rate.

The railroads asked the reduced rate originally, to meet the competition of trucks that are carrying the materials to construction jobs from pits near Milwaukee. In making application for the reduced rate a year ago the railroads made it known in hearings before the Commission that they were losing considerable business because of the fact that they would not haul the materials from points throughout the state as cheaply as the trucking companies could haul it from pits near the city.

The commission granted a 25% reduction in the regular rate for the year, and the railroads seek another year's extension, to determine whether or not a permanent rate of this kind will prove advantageous in the long run.—*Madison* (Wis.) *Times.*

To Consider Mississippi Sand and Gravel Rates

THE petition of the Mississippi Sand and Gravel Producers versus all railroads and parties in interest will come definitely at the April meeting of the Mississippi Railroad Commission, it was decided just prior to the adjournment of the rail body. Another important case on the March docket, that of the case of the Mississippi railroad commission against all railroads in the state asking for a surcharge on fertilizer and fertilizer material between points in the state, was taken under advisement.

The granted petitions included elimination of the New Hope Gravel Co. from the list of industries within switching limits of Columbus.

Protest Agricultural Limestone Rates in Tennessee

THE TENNESSEE State Railroad and Public Utilities Commission has started hearing the complaint of the Franklin Limestone Co. and the American Limestone Co., which concerns are protesting the recent increased tariffs which the carriers sought to put in one agricultural limestone.

The commission had previously suspended the new tariffs pending a hearing.

It developed that an effort would be made to bring about a compromise rate, the carriers agreeing that such shipments when made in open cars should take the same rate as crushed stone for roadbuilding purposes. —*Nashville* (Tenn.) *Banner.*

New Gravel Rates in Illinois

ENABLING producers of sand, gravel and crushed stone in southern Illinois to compete successfully with other producers beyond the state's borders, the Illinois Commerce Commission has order into effect a general readjustment of transportation rates on these commodities. These new rates will apply to all destination points within and from points of origin both inside and outside of that territory. Producing plants near Anna, East St. Louis, Cairo, Chester, Metropolis, Joppa and Mount Carmel, are among those affected by the order.—*St. Louis* (Mo.) *Post Dispatch.*

Portland Cement Production, February

THE PORTLAND CEMENT INDUSTRY in February, 1932, produced 3,971,000 bbl., shipped 3,118,000 bbl. from the mills and had in stock at the end of the month 26,631,000 bbl. Production of portland cement in February, 1932, showed a decrease of 32.9% and shipments a decrease of 38.5%, as compared with February, 1931. Portland cement stocks at the mills were 6.9% lower than a year ago.

The statistics here presented are compiled from reports for February, received by the Bureau of Mines from all manufacturing plants except four, for which estimates have been included in lieu of actual returns.

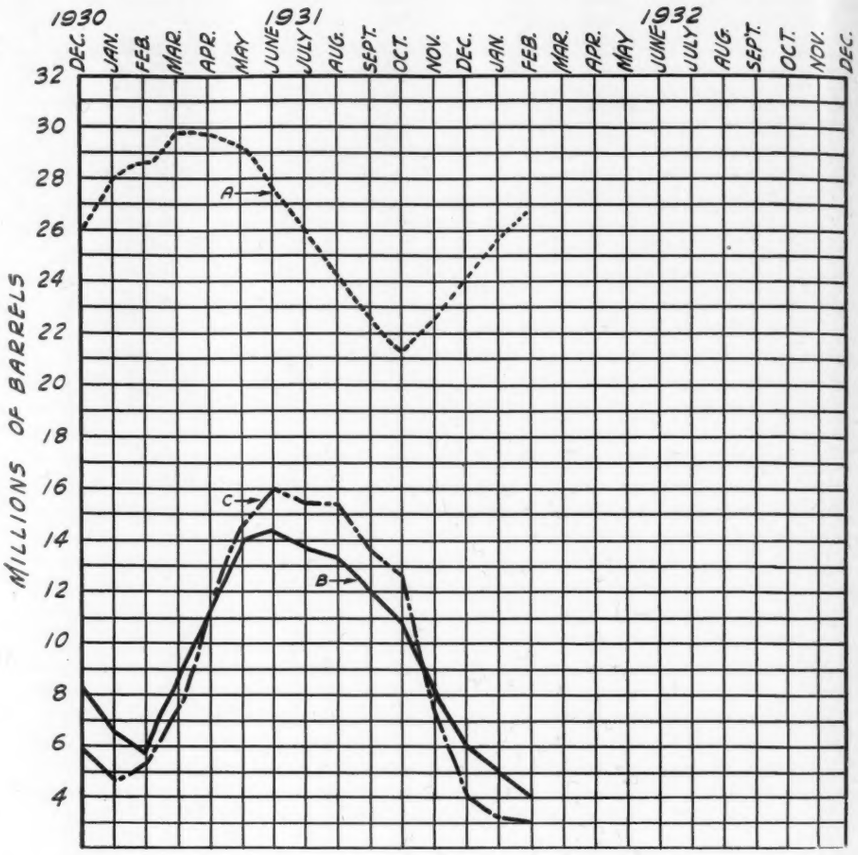
In the following statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 165 plants both at the close of February, 1932, and of February, 1931. The estimates include increased capacity due to extensions and improvements during the period.

RELATION OF PRODUCTION TO CAPACITY

	Feb. 1931 Pct.	Feb. 1932 Pct.	Jan. 1932 Pct.	Dec. 1931 Pct.	Nov. 1931 Pct.
The month	29.4	18.7	22.0	26.4	37.2
12 months ended	59.7	45.2	45.9	46.5	44.4

Distribution of Cement

The following figures show shipments from portland cement mills distributed among the states to which cement was shipped during December, 1930 and 1931, and January, 1931 and 1932, and in the years 1930 and 1931:


1930
1931
1932
DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
MILLIONS OF BARRELS
32 30 28 26 24 22 20 18 16 14 12 10 8 6 4
A
B
C

(A) Stocks of finished portland cement at factories; (B) Production of finished portland cement; (C) Shipments of finished portland cement from factories

PORTLAND CEMENT SHIPPED FROM MILLS INTO STATES IN DECEMBER AND JANUARY, 1930 AND 1931, IN BARRELS*

Shipped to	1930—Dec.—	1931	1931—Jan.—	1932	1930†—Year—	1931‡
Alabama	77,946	21,963	88,798	29,065	1,273,632	1,249,034
Alaska	142	25	11	132	18,296	12,169
Arizona	30,171	15,640	36,015	12,426	462,560	431,584
Arkansas	63,553	17,112	54,904	19,588	1,459,388	1,214,774
California	704,699	322,270	580,888	371,260	9,426,837	6,693,082
Colorado	19,474	22,047	20,937	13,598	843,983	775,272
Connecticut	68,997	51,564	40,081	37,618	1,754,324	1,472,971
Delaware	12,883	11,461	10,916	13,150	373,672	346,755
Dist. of Columbia	59,861	77,875	53,960	59,606	1,078,729	1,247,649
Florida	60,233	33,081	64,038	27,586	1,056,549	763,379
Georgia	86,898	83,222	83,687	100,950	1,561,775	1,713,869
Hawaii	19,770	12,473	24,971	16,983	262,798	265,444
Idaho	4,829	3,286	4,465	2,359	311,800	189,156
Illinois	247,845	193,244	195,146	103,901	11,164,248	7,921,936
Indiana	80,190	72,495	79,310	48,366	4,927,894	3,868,895
Iowa	40,965	34,916	30,333	22,943	6,411,595	3,796,566
Kansas	78,186	86,455	70,951	27,495	2,398,123	2,082,549
Kentucky	54,631	49.417	56,581	44,852	1,695,202	1,727,034
Louisiana	130,600	77,914	133,695	77,633	2,892,404	3,904,095
Maine	26,759	11,145	8,263	6,847	835,795	521,440
Maryland	84 223	133,256	48,532	87,662	2,555,386	2,013,446
Massachusetts	153,583	110,738	106,524	87,756	3,090,962	3,038,015
Michigan	194,610	119,925	174,367	92,394	8,625,691	5,533,394
Minnesota	64,412	35,166	46,987	31,018	3,668,645	3,730,923
Mississippi	32,986	5,820	37,644	14,040	619,649	529,167
Missouri	188,762	178,052	167,209	77,383	6,145,380	4,251,068
Montana	9,612	3,697	9,502	3,494	319,214	262,586
Nebraska	21,890	25,655	16,464	6,897	1,675,904	1,902,711
Nevada	1,916	12,587	2,455	10,308	147,243	130,475
New Hampshire	12,673	9,272	6,586	7,667	559,958	436,045
New Jersey	259,936	212,095	135,679	165,341	6,536,136	5,048,367
New Mexico	12,929	9,934	12,200	6,292	298,111	264,627
New York	867,187	760,928	653,705	590,166	20,147,426	19,716,039
North Carolina	42,274	35,452	30,352	37,779	1,165,162	1,014,331
North Dakota	2,352	1,258	2,737	942	337,888	257,807
Ohio	238,538	194,959	188,631	161,775	9,698,510	6,387,760
Oklahoma	135,784	121,420	115,140	81,230	3,396,549	2,313,445
Oregon	53,936	16,332	36,696	26,097	1,070,341	925,491
Pennsylvania	431,241	298,610	323,776	251,407	13,795,600	7,635,186
Porto Rico	6,918	8,525	620	2,725	40,065	64,404
Rhode Island	20,270	26,601	13,249	22,151	704,943	568,900
South Carolina	132,992	52,483	170,545	33,652	1,654,951	2,250,997
South Dakota	7,187	8,749	6,533	3,721	540,867	637,073
Tennessee	74,077	44,322	65,246	36,629	2,410,519	1,412,929
Texas	339,964	223,504	327,904	255,469	6,417,951	5,662,775
Utah	4,271	6,861	6,075	6,730	417,472	289,253
Vermont	2,678	5,602	2,869	2,937	582,495	310,842
Virginia	77,370	78,200	61,804	64,365	1,648,052	1,595,762
Washington	185,135	50,654	110,948	45,904	3,102,088	2,085,433
West Virginia	56,245	50,176	52,512	45,752	1,598,843	1,367,969
Wisconsin	62,793	73,102	66,531	54,214	4,974,591	3,975,841
Wyoming	3,028	2,661	4,854	1,261	178,873	136,865
Unspecified	427	0	25,533	15,671	15,865	129,935
	5,650,831	4,114,201	4,668,359	3,367,187	158,350,934	126,077,514
Foreign countries	37,169	27,799	23,641	25,813	708,400	387,486
Total shipped from cement mills	5,688,000	4,142,000	4,692,000	3,393,000	159,059,334	126,465,000

*Includes estimated distribution of shipments from 2 mills in December, 1930, and January, 1932; from 3 mills in December and January, 1931. †Final figures. ‡Compiled from monthly reports of the producers; includes estimated distribution of shipments from 3 to 4 mills each month.

PRODUCTION AND STOCKS OF CLINKER BY MONTHS, IN 1931 AND 1932, IN BARRELS

Month	1931—Production—	1932	Stocks at end of month 1931	1932	Month	1931—Production—	1932	Stocks at end of month 1931	1932
January	8,129,000	6,107,000	10,384,000	*8,184,000	July	12,246,000		10,209,000	
February	7,473,000	5,176,000	11,946,000	9,404,000	August	11,664,000		8,468,000	
March	9,586,000		13,318,000		September	10,414,000		6,918,000	
April	11,540,000		13,854,000		October	9,825,000		6,021,000	
May	13,159,000		13,087,000		November	8,259,000		6,215,000	
June	12,679,000		11,837,000		December	6,840,000		*7,035,000	

*Revised.

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS, IN FEBRUARY, 1931 AND 1932, AND STOCKS IN JANUARY, 1932, IN BARRELS

District	Production 1931	Production Feb.—1932	Shipments 1931	Shipments Feb.—1932	Stocks at end of month 1931	Stocks at end of month 1932	Stocks at end of Jan., 1932*
Eastern Penn., N. J., Md.	1,630,000	1,315,000	1,123,000	851,000	6,054,000	5,706,000	5,242,000
New York and Maine	151,000	319,000	182,000	166,000	1,957,000	1,575,000	1,423,000
Ohio, Western Penn., W.Va.	412,000	215,000	415,000	284,000	3,705,000	3,405,000	3,474,000
Michigan	109,000	114,000	219,000	121,000	2,814,000	2,093,000	2,099,000
Wis., Ill., Ind. and Ky.	427,000	515,000	416,000	249,000	3,966,000	3,386,000	3,120,000
Va., Tenn., Ala., Ga., Fla. & La.	836,000	290,000	768,000	359,000	1,833,000	1,749,000	1,817,000
East'n Mo., Ia., Minn., S.D.	766,000	358,000	377,000	150,000	3,458,000	3,698,000	3,491,000
West'n Mo., Nebraska, Kansas, Oklahoma and Arkansas	263,000	179,000	404,000	239,000	2,077,000	1,942,000	2,003,000
Texas	286,000	280,000	328,000	256,000	740,000	847,000	823,000
Colo., Mont., Utah, Wyo., Ida.	160,000	7,000	82,000	38,000	486,000	456,000	486,000
California	709,000	316,000	602,000	343,000	938,000	1,124,000	1,151,000
Oregon and Washington	171,000	63,000	158,000	62,000	584,000	650,000	649,000
	5,920,000	3,971,000	5,074,000	3,118,000	28,612,000	26,631,000	25,778,000

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1931 AND 1932, IN BARRELS

Month	1931—Production	1932	1931—Shipments	1932	Stocks at end of month 1931	1932
January	6,595,000	*5,026,000	4,692,000	*3,393,000	27,759,000	*25,778,000
February	5,920,000	3,971,000	5,074,000	3,118,000	28,612,000	26,631,000
March	8,245,000	.....	7,192,000	.....	29,676,000	.....
April	11,245,000	.....	11,184,000	.....	29,715,000	.....
May	14,010,000	.....	14,200,000	.....	29,554,000	.....
June	14,118,000	.....	16,077,000	.....	27,602,000	.....
July	13,899,000	.....	15,545,000	.....	25,934,000	.....
August	13,549,000	.....	15,172,000	.....	24,313,000	.....
September	12,092,000	.....	13,671,000	.....	22,736,000	.....
October	10,762,000	.....	12,360,000	.....	21,218,000	.....
November	8,161,000	.....	7,156,000	.....	22,219,000	.....
December	5,974,000	.....	4,142,000	.....	*24,098,000	.....
	124,570,000	.....	126,465,000	.....	.....	.....

PRODUCTION AND STOCKS OF CLINKER (UNGROUND CEMENT), BY DISTRICTS, FEBRUARY, 1931 AND 1932, IN BARRELS

District	1931—Production	1932	Stocks at end of month 1931	1932
Eastern Pennsylvania, New Jersey and Maryland	1,947,000	1,531,000	1,665,000	1,156,000
New York and Maine	326,000	443,000	1,078,000	722,000
Ohio, Western Pennsylvania and West Virginia	580,000	426,000	1,464,000	1,116,000
Michigan	380,000	200,000	1,542,000	817,000
Wisconsin, Illinois, Indiana and Kentucky	891,000	904,000	1,558,000	1,111,000
Virginia, Tennessee, Alabama, Georgia, Florida, Louisiana	749,000	314,000	872,000	808,000
Eastern Missouri, Iowa, Minnesota and South Dakota	896,000	341,000	727,000	442,000
Western Missouri, Nebraska, Kansas, Oklahoma, Arkansas	388,000	320,000	791,000	807,000
Texas	292,000	219,000	348,000	239,000
Colorado, Montana, Utah, Wyoming and Idaho	160,000	35,000	276,000	190,000
California	706,000	408,000	1,141,000	1,623,000
Oregon and Washington	158,000	35,000	484,000	373,000
	7,473,000	5,176,000	11,946,000	9,404,000

EXPORTS AND IMPORTS OF HYDRAULIC CEMENT, BY MONTHS, IN 1931 AND 1932

Month	1931—Exports Barrels	Value	1932 Barrels	Value	1931—Imports‡ Barrels	Value	1932 Barrels	Value
January	41,199	$ 115,678	36,704	$ 82,984	95,609	$ 120,298	14,375	$ 16,648
February	25,703	88,989	.....	.....	21,984	25,391	.....	.....
March	54,599	144,579	.....	.....	70,378	80,360	.....	.....
April	40,478	116,564	.....	.....	53,333	58,576	.....	.....
May	48,028	140,953	.....	.....	19,325	20,568	.....	.....
June	43,597	107,610	.....	.....	32,079	42,955	.....	.....
July	29,344	97,837	.....	.....	14,332	15,582	.....	.....
August	39,517	106,643	.....	.....	8,895	11,739	.....	.....
September	27,570	81,399	.....	.....	33,574	33,520	.....	.....
October	24,531	68,524	.....	.....	39,642	42,380	.....	.....
November	33,200	97,796	.....	.....	27,940	22,235	.....	.....
December	21,887	54,028	.....	.....	40,147	34,314	.....	.....
	429,653	$1,220,600	.....	.....	457,238	$507,918	.....	.....

DOMESTIC HYDRAULIC CEMENT SHIPPED TO ALASKA, HAWAII AND PORTO RICO IN JANUARY, 1932

	Barrels	Value
Alaska	492	$ 1,342
Hawaii	12,465	30,538
Porto Rico	3,062	4,655
	16,019	$36,535

*The value of exports of domestic cement is the actual cost at the time of exportation in the ports of the United States whence they are exported, as declared by the shippers on the export declarations.

†The value of imported cement represents the foreign market value at the time of exportation to the United States.

‡Includes hydraulic cement clinker and white nonstaining portland cement.

Exports and Imports†*

Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES IN JANUARY, 1932

Exported to	Barrels	Value
Canada	1,319	$ 4,102
Central America	23,196	36,628
Cuba	1,910	3,980
Other West Indies	170	396
Mexico	914	2,610
South America	6,852	23,450
Other countries	2,343	11,818
	36,704	$82,984

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS, IN JANUARY, 1932

Imported from	District into which imported	Barrels	Value
Belgium	Porto Rico	1,264	$ 1,750
Cuba	Porto Rico	4,295	6,015
Denmark	Porto Rico	6,012	5,097
France	New York	211	755
Germany	Philadelphia	293	149
Japan	Hawaii	2,000	1,982
United Kingdom	New York	300	900
	Total	14,375	$16,648

Erratum

IN THE ABSTRACT of F. H. Jackson's paper, "What the Water-Cement Ratio Theory Means to the Aggregate Producer," on page 48 in the February 27 issue of ROCK PRODUCTS, it was stated that a committee of the Highway Research Board had recommended a water-cement ratio of 0.8 as the lowest in concrete exposed to weather. Obviously the word "lowest" should have been "highest," as the Bureau of Public Roads does not recommend more than 6 gal. of water per sack of cement.

RETAIL MATERIAL PRICES, DELIVERED, FEBRUARY 1, 1932 (COMPILED BY DEPARTMENT OF COMMERCE)

City	Portland cement, per bbl. exclu. of cont.	Gypsum wallboard, ⅜-in., per M	Hydrated lime, per ton	Building sand, per cu. yd.	Crushed stone, ¾-in., per ton	Gypsum plaster, neat, per ton
New Haven, Conn.	$2.40	.....	$15.00	$1.50	$2.00	.....
New London, Conn.	2.05	25.00	18.00	1.20	2.50	$18.00
Waterbury, Conn.	2.60	30.00	20.00	1.25	2.45	20.00
Haverhill, Mass.	2.60	25.00	.....	.....	.....	18.50
New Bedford, Mass.	2.40	24.00	16.25	1.50	2.75	16.50
Albany, N. Y.	2.34	23.85	15.75	.....	.....	16.20
Buffalo, N. Y.	2.95	21.00	18.00	2.50	2.03	16.00
Poughkeepsie, N. Y.	1.95	.....	26.00	2.25	2.20	13.00
Rochester, N. Y.	2.28	22.00	14.50	2.25	2.40	16.00
Syracuse, N. Y.	2.60	20.00	.....	1.80	1.60	14.00
Paterson, N. J.	2.00	24.00	18.00	1.50	2.10	17.50
Trenton, N. J.	2.10	23.00	18.00	.90	1.05	16.75
Erie, Penn.	2.10	22.50	16.00	2.00	.....	16.00
Philadelphia, Penn.	2.10	.....	13.75	1.75	2.60	17.50
Scranton, Penn.	2.40	.....	20.00	4.39	.....	19.00
Baltimore, Md.	2.10	25.00	13.00	1.85	2.50	14.50
Washington, D. C.	1.65	25.00	12.00	.....	.....	14.00
Richmond, Va.	2.90	.....	21.00	1.65	2.10	18.00
Fairmont, W. Va.	2.75	35.00	16.00	2.70	3.50	18.00
Columbia, S. C.	2.28	35.00	11.00	1.50	2.60	17.00
Atlanta, Ga.	2.55	36.00	15.50	2.81	2.50	20.25
Savannah, Ga.	2.35	27.50	21.50	1.75	3.50	16.50
Tampa, Fla.	2.60	.....	24.00	2.00	3.25	20.00
New Orleans, La.	2.35	37.20	14.00	2.75	.....	18.00
Akron, Ohio	$1.74	.....	$12.00	$1.50	$2.50	$14.00
Cincinnati, Ohio	1.94	22.75	14.40	2.63	2.55	.....
Cleveland, Ohio	2.00	.....	10.00	1.69	2.15	15.00
Columbus, Ohio	2.35	.....	12.00	1.50	2.75	14.40
Toledo, Ohio	1.40	20.00	12.00	1.60	1.60	14.00
Youngstown, Ohio	2.43	23.25	16.00	2.50	2.50	18.00
Detroit, Mich.	2.00	25.00	12.00	2.03	1.75	15.00
Lansing, Mich.	2.25	.....	20.00	1.80	1.80	17.50
Saginaw, Mich.	1.90	25.00	16.00	2.50	2.20	18.00
Terre Haute, Ind.	2.00	28.00	18.00	1.25	3.00	18.00
Louisville, Ky.	1.85	.....	15.00	2.00	2.15	17.00
Milwaukee, Wis.	1.20	22.00	.....	1.25	1.25	.....
Des Moines, Iowa	1.82	23.50	18.00	1.40	4.15	14.00
Wichita, Kan.	1.75	25.00	22.50	1.00	.....	15.50
Kansas City, Mo.	2.10	25.00	22.00	1.60	1.88	17.00
St. Louis, Mo.	2.00	.....	16.00	1.35	1.65	16.00
St. Paul, Minn.	2.15	21.00	19.00	1.25	1.75	17.00
Grand Forks, N. D.	2.60	.....	16.25	2.60	.....	18.75
Sioux Falls, S. D.	2.00	40.00	22.00	1.25	2.00	15.00
Tulsa, Okla.	1.90	22.50	22.50	.85	2.35	16.00
San Antonio, Tex.	2.41	42.00	20.00	2.15	2.35	17.15
Tucson, Ariz.	3.29	45.00	29.00	1.25	2.25	17.10
Los Angeles, Calif.	2.30	23.50	24.70	1.85	1.90	15.20
San Francisco, Calif.	2.25	45.00	22.50	1.40	1.60	17.30

Asphalt Technologists Create New Committees

TWO new standing committees to study and report on new phases of asphalt technical development for the organization were created by the Association of Asphalt Paving Technologists at its annual business meeting, January 13, in Detroit during the convention and road show of the American Road Builders Association. These committees are the committee on asphalt plant and equipment, of which John W. Davitt, Jersey City, N. J., is chairman, and the committee on production of asphalt cement, of which Charles M. Baskin, Imperial Oil Refineries, Ltd., Montreal, Que., is the chairman.

The purpose of Mr. Davitt's committee is to devise and recommend improvements in asphalt mixing and paving plants and other equipment that will insure a better quality and quantity of output and effect economies in operation. The committee headed by Mr. Baskin will develop information on the characteristics of asphalt cements as they relate to the various processes of production, with a view to furnishing engineers advice and assistance that will enable them to prepare paving mixtures best adapted to meet particular conditions that may confront them in their local situations. The members of the two new committees will be appointed by the chairmen in the near future. Messrs. Davitt and Baskin also were elected to the board of directors at this meeting.

The following officers were elected for the year 1932: President, Henry L. Howe, Rochester, N. Y.; first vice-president, Roger L. Morrison, Ann Arbor, Mich.; second vice-president, George W. Craig, Chicago, Ill.; secretary-treasurer, Charles A. Mullen, Montreal, Que., Canada.

The proceedings and papers of the technical meeting will be published in the technical press and distributed later in pamphlet form by The Asphalt Institute, New York.

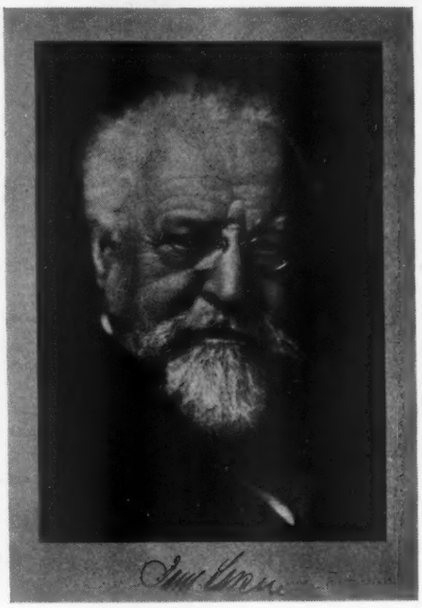
F. L. Smidth and Co. Celebrates Fiftieth Anniversary

AN attractively printed 150-page report in the Danish language has been published by F. L. Smidth and Co. on the occasion of the fiftieth anniversary of the company. This is a continuation of a similar report published on the occasion of the company's fortieth anniversary and shows the growth of the company and its developments, with illustrations and descriptions of a number of the plants built by it.

The firm was founded in 1882 at Copenhagen, Denmark, and at first specialized in flour mill and brick plants. This led to the installation of cement plants, the first being erected in Sweden in 1888, followed by several Danish and Scandinavian plants in the next few years. A London branch was established in 1890, a Paris branch in 1893, and a New York branch in 1895.

In 1899 the founder, F. L. Smidth, died and the business was carried on by his two partners, Paul Larsen and Alexander Foss. Following the death of Mr. Foss in 1925, the firm was reorganized and continued as a stock company with Mr. Larsen as president and general manager.

The company has been responsible for many improvements of the machinery used in the manufacture of cement, particularly the Unax kiln and cooler, Unidan grinding mill, the use of long rotary kilns, Symetro gear drives, the Fluxo rotary packer for



Paul Larsen

packing cement into valve bags, the process for making Velo quick-hardening cement and many others. More than 150 Unax kilns and 400 Unidan mills are understood to have been installed.

In addition to these various machinery developments the company has in recent years taken a prominent part in the formation of new companies and has made close connections with operating companies so that it occupies a unique position not only in the cement machinery industry but in the cement industry itself.

Harry F. Ostrander

HARRY F. OSTRANDER, 57, president, Pioneer Sand and Gravel Co., Seattle, Wash., died at the Johns Hopkins hospital in Baltimore, Md., on March 4 from complications following an operation. He had been a patient in the hospital since December.

Mr. Ostrander was born in Wisconsin but moved to Washington when 9 years old. He has been active both in the business and civic life of Washington for many years.

Beside his interest in the Pioneer company he was a director of the Centennial Mills Co. and of the Pacific National bank. He had also been active in Oriental trade since 1910.

State and Local Road Funds for Year to Exceed Billion

THE TOTAL FUNDS available for public road and bridge construction and maintenance in the United States during 1932 are estimated at $1,353,000,000, the Bureau of Public Roads, Department of Agriculture, stated March 19. Of this amount $882,000,000 is the probable expenditure by state highway departments and $471,000,000, it is expected, will be spent by local authorities.

The total estimated expenditure of the state highway departments of $882,000,000 is divided as follows: Construction of roads and bridges, $568,000,000; reconstruction and maintenance, $197,000,000; interest on highway bonds, $64,000,000, and miscellaneous, $53,000,000.

The state highway departments plan to construct 36,000 miles of road. This mileage includes 8800 miles of high-type road, such as asphalt, concrete and brick; 17,500 miles of macadam, gravel and sand-clay, and 9000 miles of graded earth. There is also to be constructed approximately 700 miles of road in New York not distributed by types and the mileage to be constructed in Connecticut and Florida is not included. The state highway departments will maintain 314,900 miles of road.

Similar information concerning local funds and mileage is not available.

The states with state highway programs in excess of $50,000,000 are listed in order of size of program as follows: Pennsylvania, New York, Illinois, California, New Jersey, Ohio, Texas, Missouri and Michigan.

The local program of road construction will exceed $25,000,000 in the following states, which are listed in order of size of program: Pennsylvania, New York, California, Ohio and Illinois.

G. P. Torrence Elected President of Link-Belt

GEORGE PAULL TORRENCE, former vice-president in charge of the company's Indianapolis operations, has been elected president of the Link-Belt Co., Chicago, Ill. Mr. Torrence was graduated from Purdue University in 1908. Following graduation, Mr. Torrence spent a year in Arkansas with the Ayer and Lord Tie Co. Then came a two-year shop apprentice course in the Pittsburgh shops of Westinghouse Air Brake Co., following which, in the year 1911, he entered the employ of Link-Belt Co. in Indianapolis as a sales engineer.

In 1915 Mr. Torrence was placed in charge of merchandise and chain sales in the company's western division, with headquarters in Chicago. In 1920 he returned to Indianapolis as sales manager of the Ewart Works; in 1925 he was made general manager of both the Dodge and Ewart plants; and in 1928, vice-president of the company, with headquarters in Indianapolis. His next step was into the presidency.

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Ready-Mixed Concrete Co., Portland, Oregon

By W. A. Scott

THE READY-MIXED CONCRETE CO., Portland, Ore., has two ready-mix plants, both on the east bank of the Willamette river, and about 4 miles apart. At both points these stand alongside the large capacity bunkers of the Ross Island Sand and Gravel Co., from which the aggregates are drawn. Harold Blake is manager of both companies.

During these times of light demand, the ready-mix operations are confined to the plant at the foot of Randolph street, which is the more central of the two. Here the storage bunkers of the Ross Island company, about 300 ft. long, extend out at right angles to the waterfront. The material is delivered in barges and unloaded by clamshell bucket to a hopper from which it is fed to a distributing belt extending the full length of the bunkers. About two-thirds of this storage is for the different grades of gravel and the balance is for sand.

Materials of the grades required for the ready-mix plant are drawn through chutes on to two belt conveyors that serve the latter plant. The first of these, a 200-ft. belt, carries gravel; the second, 100 ft. long, carries sand. The two belts discharge at a common point to the boot of a bucket elevator which carries the materials up to the four aggregate bins at the top of the mixing plant. From these bins the materials are drawn to a Toledo scale and weighing hopper of 5 cu. yd. capacity. The requisite proportions of aggregates and cement are discharged through a lever-operated gate into a 3-yd. concrete mixer.

The relative proportions of ingredients for the mixer batch, of course, are governed by the specifications for the various classes of construction work. The water for the mixer batch amounts to 6 to 7½ gals. per sack of cement, including that carried in the aggregates, the sand being tested to determine its water content.

Plant of Ready-Mixed Concrete Co., Portland, Oregon

The principal change within the last year, as to ready-mix delivery to construction jobs, consists of using trucks equipped with rotating concrete carriers, each of 3-yd. capacity, instead of those having the bath-tub type of bed. The cylindrical carrier, operated at a speed 4 to 6 r.p.m. by a separate motor on the truck, is not rotated during transit, but only on arrival at the job. This results in a remixing of the concrete mass and the recombining with it of any free water which may be present.

The Pacific Building Materials Co., Portland, controlled by Harold Blake, besides being a sales concern, is a producer of ready-mixed lime mortar, lime putty and brick-laying mortar. The plant for these processes is on the steep slope of a bluff, allowing all material to be handled by gravity. About 14 to 15 bbl. of lime are slacked at a time. All ready-mixed mortar for plastering and brick work and hard-finish coating is delivered in dump trucks of 3½ cu. yd. capacity. Another product is California stucco, in colors, for which Del Monte white silica is used. The mixture is made here for interior and exterior colored stucco work. Ready-mix mortars, stucco and other material from this plant were furnished for a number of modern buildings recently erected in Portland.

Making Uniform Concrete in Mixed Concrete Plant

T. C. POWERS, associate engineer of the Portland Cement Association tells in a recent issue of the *Engineering News-Record* how uniform concrete was made in a mixed concrete plant. Uniformity in this case included uniformity in yield, grading, consistency and water-cement ratio. Grading was kept constant by having two sands, one of fine material and the other a coarse paving sand. Consistency and water-cement ratio and yield were kept constant by a rule that was worked out by trial.

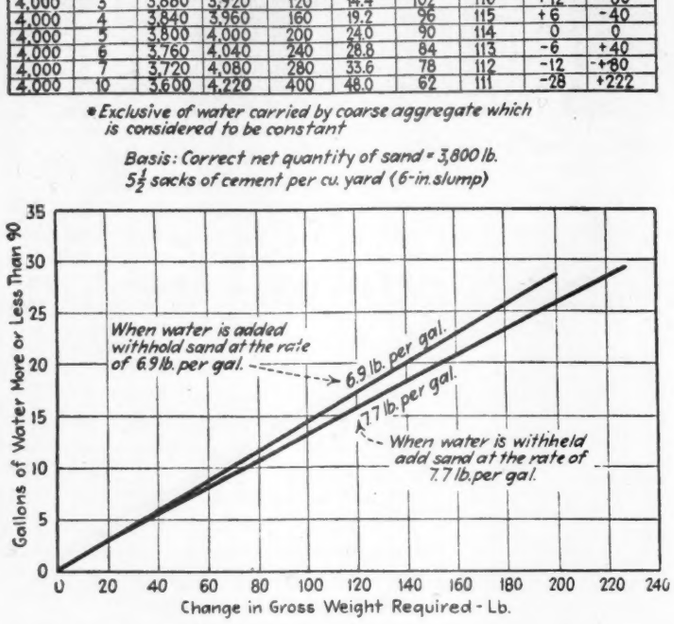
The coarse aggregate, stone, was in two sizes, ¼- to ¾-in. and ¾- to 1¼-in. All batching was done by weighing. Under these circumstances practically all variations in consistency were due to variations in the moisture carried by the aggregates.

If there was an increase in the amount of water carried by the sand ordinarily less mixing water would have to be added and this would decrease the yield somewhat if

1	2	3	4	5		6	7	8	9
Gross Wt. of sand Lb.	Moisture in sand,%	Net Wt. of sand Lb.	Correct gross Wt., Lb.	Water weighed in with sand Lb.	Gal	Water added Gal.	*Total water Gal.	Diff. in water Gal.	Diff. in gross wt. reqd, Lb.
4,000	0	4,000	3,800	0	0	118	118	+28	-200
4,000	3	3,880	3,920	120	14.4	102	116	+12	-80
4,000	4	3,840	3,960	160	19.2	96	115	+6	-40
4,000	5	3,800	4,000	200	24.0	90	114	0	0
4,000	6	3,760	4,040	240	28.8	84	113	-6	+40
4,000	7	3,720	4,080	280	33.6	78	112	-12	+80
4,000	10	3,600	4,220	400	48.0	62	111	-28	+222

*Exclusive of water carried by coarse aggregate which is considered to be constant

Basis: Correct net quantity of sand = 3,800 lb.
5½ sacks of cement per cu. yard (6-in. slump)


Gallons of Water More or Less Than 90
When water is added withhold sand at the rate of 6.9 lb. per gal.
6.9 lb. per gal.
7.7 lb. per gal.
When water is withheld add sand at the rate of 7.7 lb. per gal.
Change in Gross Weight Required - Lb.

Data obtained in determining weight-correcting factors

constant consistency was maintained. So a table was worked out by which the weight of the material that carried the water was varied. This had to be worked out by trial because, for example, if an increase of water in the sand of 200 lb. gave 200 lb. less sand this would reduce the water required for constant consistency by 200 lb. and an additional amount due to the fact that there was 200 lb. less sand than before. From the data secured by trial the following rule was laid down for the guidance of the mixer man:

Rule

"If, for the given total weights shown in the table of mixtures, the proper consistency is found with a quantity of water other than that shown in the table, adjust the weights as follows:

"For every gallon of water withheld, increase by 8 lb. the weight of the material in which the moisture change has taken place.

"For every gallon of water added, reduce the weight of the batch 7 lb., by reducing the weight of the material in which the moisture content has changed."

The base mix was that of 4000 lb. sand with 5% moisture, as shown in column 8 of the table. The way that additions and subtractions were made is illustrated by the following example: Suppose that instead of the 90 gal. only 62 gal. had to be used with the 3-yd. batch to get the required consistency. The quantity of water withheld was then 90 — 62, or 28 gal. Applying the rule, 8 lb. increase in weight for each gal. withheld, the gross weight would be increased 8 × 28, or 224 lb., making it 4224 lb. (This nearly corresponds to 10% moisture in the sand, according to the table.) The operator had to be cautioned not to make mistakes where there were more corrections than one. If he had to add 3 gal. more than he had at first figured he was apt to use the rule for a difference between 65 gal. and 90 gal. for a new correction. But the rule only applies to the gross weights given in the table on which the rule is based. For other weights corrections have to be made.

The author says that in this plant the major variations were all in the coarse sand, so its weight was all that was affected. But in other plants other materials might vary in moisture content, and it might be necessary to find rules for changing two or more divisions of the aggregate.

Minor variations in the grading were almost automatically taken care of by the rule, as a coarser sand required less water but more sand had to be added for workability. The rule should be checked by laboratory investigations for wider variations in grading.

Report of Committee on Central and Truck Mixed Concrete

THE report of the committee on central and truck mixed concrete of the American Road Builders Association at the Detroit convention, January, 1932, has been published and is given in abstract below.

At the 1931 convention the committee reported that the principal objections raised by state and municipal engineers to the use of this product in street and highway construction were: segregation, damage to subgrade by hauling equipment, difficulty of transfer of the product from the hauling unit to the subgrade and lack of control. The present report indicates that considerable progress has been made in overcoming these objections.

Segregation, according to the report, has been definitely overcome in the up-to-date plant by careful preparation of the concrete and close attention to the gradation of the aggregates and consistency of the mix. Concrete prepared from carefully graded aggregates, scientifically proportioned and properly mixed in either a central mixing plant or a truck mixer, can be hauled without segregation for a distance or length of time far in excess of the economic limit of such haul.

Damage to the subgrade by the hauling equipment is hard to overcome but it must be remembered that on the vast majority of pavement yardage the subgrade is of such type as to give little or no difficulty along this line. Again, the work may be so constructed as to pour the concrete from outside the forms, thus eliminating the necessity for the operation of trucks on the finished subgrade. Many pavements, particularly where the width is 20 ft. or more, are being built in lanes. Such construction permits, at all times, the pouring from outside the forms. More than 10 different designs of equipment for transferring the product from the hauling unit to the subgrade are in the process of development. The most serious objection to the majority of these designs is the cost of the equipment.

Some equipment of this type has been used and has operated satisfactorily, but further improvement is necessary. It is thought that another year will see such equipment developed to a highly satisfactory degree.

The objection of lack of control is stated to have been largely overcome. Variations in the surface moisture of the aggregates can be compensated for, although requiring several minutes and involving changes in scale settings and bringing in the human element. The fact that the ready mixed operation is performed away from the job and if inaccurately done renders useless the most rigid job inspection, has been an objection. However, a practically identical method has been used satisfactorily for years in the manufacture of hot bituminous mixes.

The tendency to add excess cement to insure satisfactory strength test results increases the cost of concrete and could be avoided by more complete control which would assure uniform high quality and permit the use of lower factors of safety. During the past year many improvements have been made in the control of the mix which it is believed will overcome such objections.

With scientific design and batching being more and more placed in the hands of responsible technical men, the committee believes that 1932 will see engineers convinced that these objections have been overcome.

Ready-Mixed Concrete Bibliography

THE National Ready-Mixed Concrete Association has issued a bibliography of literature on ready-mixed concrete. The list also includes references to bibliographies prepared by the Portland Cement Association and the National Slag Association. The bibliography appears to be quite complete and should be of value and interest to the industry.

New Light Weight Gypsum Flooring System

A NEW flooring system using light weight gypsum units carried on the lower flanges of steel floor beams was demonstrated recently in the construction of the Rothschild building addition in Chicago. It is known as the "Unitrave" system and was developed by the Unitrave Engineering Co., Chicago, Ill. This first installation was by the Avery Brundage Co., contractors.

The system provides for the placing of cored gypsum units on the lower flanges of steel beams as shown in one of the accompanying illustrations. The construction of the units is such that by tilting they can be slipped into place, a projecting lug on each end holding them for grouting.

Concrete is then poured over the top of the gypsum units and this may be reinforced or not, depending upon the thickness and design. The gypsum units are said to be able to carry safely a live load of 250 lb. per sq. ft., but are used as a form for the concrete and a base for the plaster rather than to carry the floor load. When reinforcing is used in the concrete the top of the gypsum unit is beveled to form a V slot for the bars. The gypsum unit itself has no metal reinforcing in it. The units can be made in various sizes, such as 12 in. deep, with a flange width of 12 in. and in lengths of 4 to 7 ft.

The principal advantages resulting from this type of construction are stated to be the reduction in dead load, the greater speed of erection, the elimination of shoring and forming, the elimination of temporary floors and the completion of safe working floors immediately following the steel erection, and simplification of the plastering operation.

On this job no shoring or forming was used, the concrete being poured as fast as the units were installed on a floor. As soon as the concrete took its initial set plastering proceeded on the ceiling below.

The base of the gypsum unit extends out to protect the lower flange of the beam and forms a ceiling ready for plastering without the use of metal lath and a scratch coat, the brown coat being put on directly.

Plans as to future methods of manufacturing the gypsum tile are in the formative stage, although it is possible that the tile will be manufactured on the job. The floor system is available to all constructors. Gypsum producers may find in this an additional outlet for their products.

Avery Brundage is president of the company and S. J. Bronson is chief engineer.

Demonstrating strength of gypsum floor units

S. L. Avery Sees Profitable Year for U. S. Gypsum

"IF THE United States Gypsum Co. can get the business that it is reasonable to hope for its profits this year will approximate those of 1931," Sewell L. Avery, president, told stockholders at the company's annual meeting.

"The company has operated in the black thus far this year and can continue to do so even though conditions in the building industry become slightly worse," Mr. Avery said. Every department in the company is operating at a profit, Mr. Avery said, and he expressed confidence that this record would be continued.

Mr. Avery stated that new products, especially the gypsum paper filler, have met with good demand and should prove to be a substantial source of revenue since there is a wide market for them.

All directors were re-elected at the meeting.—*Chicago* (Ill.) *Daily News.*

New Ready-Mixed Concrete Plant in Atlanta

CROMER and Thornton, Inc., Atlanta, Ga., building material dealers, have installed a new central mixing plant and are furnishing ready-mixed concrete to the Atlanta market.

A recent article in the *Atlanta Georgian* described this new service the company is offering and showed a view of the new plant.

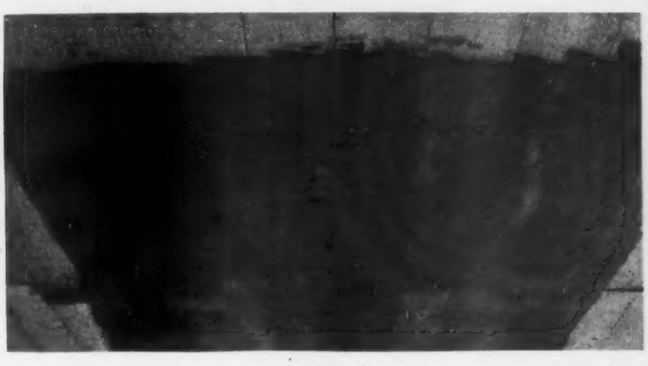
Revision of Standard for Diamond Core Drill Fittings

A PROPOSED REVISION of diamond core drill fittings commercial standard CS17-30 has been issued by the Department of Commerce.

The proposed revision is based upon new tolerances adopted by the Diamond Core Drill Manufacturers Association in order to provide for interchangeability of mating parts.

In general the changes constitute minor refinements which have developed as a result of experience with the standards.

Construction of gypsum floor unit and method of placing



The brown coat can be applied directly to the lower side

Concrete Masonry Association Sees Position Greatly Improved

Studies Past Achievements for Application to Future Growth at Annual Convention

IN KEEPING with the outstanding progress of the concrete products industry in 1931, the annual convention of the Concrete Masonry Association held in Washington, D. C., March 1-2, demonstrated the determination of the industry to carry on its march of progress with continued vigor. The program as presented proved equal to the expectations of those who attended. The application of the wealth of information which was given those in attendance should stimulate an even greater proportionate increase in the use of concrete masonry in construction.

In his opening address **D. R. Collins,** president, Concrete Masonry Association, said in part: "1931—a year which has seen many businesses perish has been a year of real accomplishment for the concrete masonry industry. A conservative survey of the industry conducted late in 1931 shows that in spite of present conditions the concrete masonry industry sold a greater percentage of masonry business during the year than in any other period in its history."

Accomplishments of 1931

Outstanding among the achievements of 1931 and without a doubt one of the greatest achievements in our industry is the fact that several hundred manufacturers, in the face of an impending year of low business, contributed the funds that made possible the carrying out of wall stability tests at the University of Illinois.

Dan F. Servey, president, the Haydite Co., Kansas City, Mo., described many projects on which concrete masonry units had been used in 1931. These varied in size from a few thousand to several hundred thousand units. He described the great interest in concrete ashlar construction by architects and builders and described promotional methods of his organization to enable it to benefit from this valuable development.

The benefits of the various national specifications which were approved during 1931 were pointed out by **D. E. Parsons,** chief, masonry construction section, Bureau of Standards, and he particularly emphasized the benefits which the industry may anticipate as a result of the A. S. T. M. specification for concrete masonry.

P. H. Bates, chief, clay and silicates products division, Bureau of Standards, urged the continuation of the research program which has been of such direct benefit to the concrete masonry industry in increasing the acceptance of its products.

The acceptance of concrete masonry in Federal construction projects by the several bureaus was outlined and plans discussed for increasing sales activity in this field.

Charles Wm. Akers, treasurer-manager, Nashville Breeko Block and Tile Co., Nashville, Tenn., described two new products, the Breeko partition tile and the Breeko floor filler unit, that have been developed by his company and which greatly increase the market for concrete masonry in large construction. The advantages and benefits resulting from the use of these products were outlined and much interest was shown by those present when they were shown that these new products now put them in a favorable competitive position in a market which now consumes several million dollars' worth of clay products each year.

Importance of Products to Cement Industry

The feature of the meeting was the talk by **W. D. M. Allen,** manager, cement products bureau, Portland Cement Association, who summarized the various investigations of masonry materials and presented charts showing the superior qualitites of concrete masonry over competitive materials and explained that with the information now available means were provided to obtain that recognition for concrete masonry which had been lacking in the past.

Another indication of the importance of the products industry to the portland cement industry was the amount of time devoted to concrete products at the meeting of the American Concrete Institute. In addition to the joint session of these two groups a number of papers of specific interest and value were presented bearing directly on the concrete products industry. These papers were reported in the March 12 issue of Rock Products.

A forward step was taken by manufacturers of concrete burial vaults, who proposed, and had accepted by the American Concrete Institute, a tentative specification for concrete burial vaults. This is another branch of the concrete products industry that is taking a broad view of its problems and is making constructive and effective efforts to solve them.

Committee on Concrete, of A. S. T. M., Has Important Standards Under Consideration

SEVERAL SUBCOMMITTEES of A. S. T. M. committee C-9 on concrete and concrete aggregates reported on important standard specifications and test methods at the meeting of the committee in Cleveland, Ohio, on Tuesday, March 8. This meeting was in conjunction with the group meetings of A. S. T. M. committees held in the Hotel Cleveland, March 7 to 11.

The subcommittee on specifications and methods of tests of aggregates has in preparation a method of test for absorption of aggregates and also presented to committee C-9 at this meeting a preliminary specification covering light-weight aggregates.

An extensive paper describing a "Study of the Dunagan Buoyancy Apparatus" was also presented to the committee. This apparatus is designed for the analysis of fresh concrete. This paper, prepared by H. R. Nettles and J. M. Holme of the Fritz Engineering Laboratory at Lehigh University, will be circulated in the committee for consideration as a committee paper looking toward possible publication in the 1933 report.

The subcommittee on ready-mixed concrete has in preparation a purchase specification for ready-mixed concrete which is expected will meet with considerable favor when available. With such a widespread use of this type concrete it is especially urgent that a standard specification be drawn up to enable all those who plan to use this material to purchase it under a definite standard.

Considerable work has also been done in the committee on tests for durability by freezing and thawing. This work will result very shortly in a suggested method of procedure for making freezing and thawing tests of concrete and concrete aggregates which will be issued as a tentative standard method.

Two papers were also submitted to the committee at this meeting. The first on "The Action of Waters on Concrete" by B. Kellam, assistant chemist of the Hydro-Electric Power Commission of Canada, records data on the action of various river and lake waters on concrete in various sections of Canada.

The second paper on "Field Survey of Concrete Structures" by E. W. Bauman, engineer of tests, Tennessee Highway Department, discusses the weathering of concrete structures in the south-central section of the country.

The committee also took action to recommend to the society certain changes in existing standard and tentative standard specifications and methods of testing concrete and concrete aggregates.

New York Sand and Gravel Companies Merge

PRACTICALLY all the sand and gravel companies in Nassau county, N. Y., operating dry pits, now are combined into one as the result of a recent merger, according to Lawrence Randall of Freeport, head of the Milburn Contracting Co.

The new concern, according to Mr. Randall, has about $500,000 worth of equipment. This new concern, which controls six sand-pits in the county, as well as several trucking concerns, is known as the Local Sand and Stone Co. of Mineola. The firms that merged included the George McCloud Corp. of Roslyn, Hendrickson Brothers of Mineola, Charles Young Co. of Westbury, Seaford Sand and Gravel Co. of Mineola and the C. B. Trucking Corp. of Mineola.

The officers of the new company are: president, Frank Hendrickson of Valley Stream; vice-presidents, Larry Randall of Freeport and Charles Young of Westbury; secretary, Walter Smith of Mineola; treasurer, Ralph Caldwell of Mineola; sales manager, George McCloud of Roslyn. Former Mayor Arthur Hendrickson of Valley Stream is a director.—*Freeport* (N. Y.) *Review.*

Edwin S. Healey

EDWIN S. HEALEY, 73, president, Glencoe Lime and Cement Co., Webster Grove, Mo., died at his home there February 29. He moved to St. Louis in 1889 from Rockland, Me.

Before engaging in the lime business Mr. Healey was connected with the Hurricane Island Granite Co. of Maine. His early association in the lime business was with the late Col. C. W. S. Cobb, who was president of the Glencoe Lime Co., and later of the Glencoe Lime and Cement Co. Mr. Healey succeeded Col. Cobb as president in 1928, Col. Cobb becoming chairman of the board of directors at that time. In his early years Mr. Healey was secretary-treasurer of the company. He had served the National Lime Association as director for a number of years and had been very active in the St. Louis Building Material Dealers' Association, serving as president, director and trustee. During the past 10 years he had been president of the Webster Grove Trust Co.

Mr. Healey, in the many years he was active in the lime business also participated in the development of the cement industry. In the early years of his life his company was agent for some of the first producers of portland cement in this country, the first of which was the Sandusky Portland Cement Co. and later for the Lehigh Portland Cement Co. After local mills were built adjacent to St. Louis his firm became their representative.

In addition to his active business life he also participated in many civic activities, both in St. Louis and in Webster Grove.

New President of National Sand and Gravel Association

THE NEW PRESIDENT of the National Sand and Gravel Association, Harold V. Owens, is such a modest gentleman that it required the combined efforts of the journalistic fraternity interested in the sand and gravel industry and of the executive secretary of the association to persuade him to have a picture taken, notwithstanding his new honor.

He is an engineer, contractor, and crushed stone producer in addition to his sand and gravel interests. Incidentally, he is also president of the most exclusive club in central New York, the Schuyler Club of Utica, nearly 100 years old.

H. V. Owens

Mr. Owens is president, treasurer and general manager of the Eastern Rock Products, Inc., which operates five sand and gravel plants and two quarries and crushed stone plants in the vicinity of Utica, with a combined output of approximately 800,000 to 1,000,000 tons per year.

Plan Tank Cars to Haul Bulk Cement

THE General American Tank Car Corp., Chicago, Ill., is preparing to introduce a new type of car for the transportation of cement, wheat and other commodities in bulk instead of in bags as previously. The new car is stated to be self-unloading and to offer many economies to the shipper compared with the present methods of handling bulk shipments in box cars and hopper cars.

New York State Will Not Require Washed Stone This Year

AT A MEETING of the New York State Crushed Stone Association at Utica, N. Y., March 10, it was announced that the New York state highway department had definitely decided not to require the washing or cleaning of crushed stone in its 1932 specifications, as it had threatened to do. An extension of at least a year's time is granted producers to install the necessary equipment.

The meeting was held in connection with the annual conventions of the New York State contractors' associations and very little business was transacted. Most of the meeting was devoted to a discussion of the problems facing the industry, created by a drastic cut in the amount of state funds available for highway work. At the same time the legislature took this action it greatly increased funds available for unemployment relief.

Governor Roosevelt was against cutting of highway appropriations and there is some reason to believe he may be induced to call a special session of the legislature to reconsider the matter.

Fires Largest Blast

THE LARGEST well-drill blast ever made was set off March 16 at the quarry of the Inland Lime and Stone Co. near Manistique, Mich. Some 5000 holes were loaded with 441,000 lb. of dynamite in an area approximately a mile long and 200 ft. wide and it was expected that about 1,250,000 tons of limestone would be dislodged. About seven miles of Cordeau-Bickford fuse was used for connecting the charges.

The blast was carefully timed and was set off on a radio signal from the Naval Observatory at Annapolis. Arrangements had been made by the U. S. Bureau of Mines to record the effects on seismographs. According to newspaper reports, a faint record was obtained on the seismograph at Georgetown University, Washington, D. C.

The report of the explosion was heard for several miles, but its effect was said to be barely perceptible in Manistique, about 20 miles away. The blast was supervised by engineers of the Hercules Powder Co. and was witnessed by officials of the company and by newsreel photographers. A more complete description of the blast will be given in a later issue.

R. H. Bacon and Co. Expands

THE R. H. Bacon and Co., Chicago, Ill., announces it has taken over the office facilities of the late I. L. Kentish-Rankin. The organization will continue to operate under the name of R. H. Bacon and Co. along the same lines as at present, but will also service Mr. Rankin's clients.

Latest in All-Steel Suction Dredges

Dredge "Three Brothers" Has Rotary Cutter, Ladder and Spuds; Uses Diesel Engine Power Through Belt Drive

THE NEW DREDGE *Three Brothers* belonging to the R. P. Emerick Dredging Co., Mount Clemens, Mich., is of all-steel construction and equipped with rotary cutter, ladder and spuds. Its 12-in. pump is an Amsco heavy duty dredging pump with belt driven full marine type thrust bearing.

The pump incorporates special features, giving a high discharge pipe line pressure and maximum vacuum in the suction line. The water end parts of the pump are all made of manganese steel, heavily proportioned and accurately machine finished where necessary to assure a correct fit when replacements are required. It is fitted with an impeller and suction side plate with distinctive features for maximum ability to handle large size boulders and gravel.

The impeller has an extra inside wall face width, amply large eye opening and special vane curvature features to give maximum hydraulic efficiency and solids capacity. The impeller is balanced and attached to its shaft by a tapered bore and auxiliary lock nut. The suction side plate of lined design embodies a long pipe opening portion of conical shape, symmetrically proportioned with the impeller to give a large, easy flow to and through the impeller. The main bearing construction is designed to provide ability to attend easily to accurate impeller adjustments when required.

The pump pulley is 34 in. in diameter and 48 in. wide, with crowned face and lagged with leather. The belt drive is the short center type furnished by the Dodge Manufacturing Corp. The pulley centers are 9 ft. 6 in. The driving or engine pulley is 66 in. in diameter and 48-in. face, crowned. In the machinery arrangement, the engine shaft center line is placed on the fore and aft center line of the dredge hull. A heavy-ply leather belt with special waterproof treatment is used. The idler tension pulley is 20 in. in diameter with 48-in. flat face, provided with hinged bearing brackets supported by floor stands.

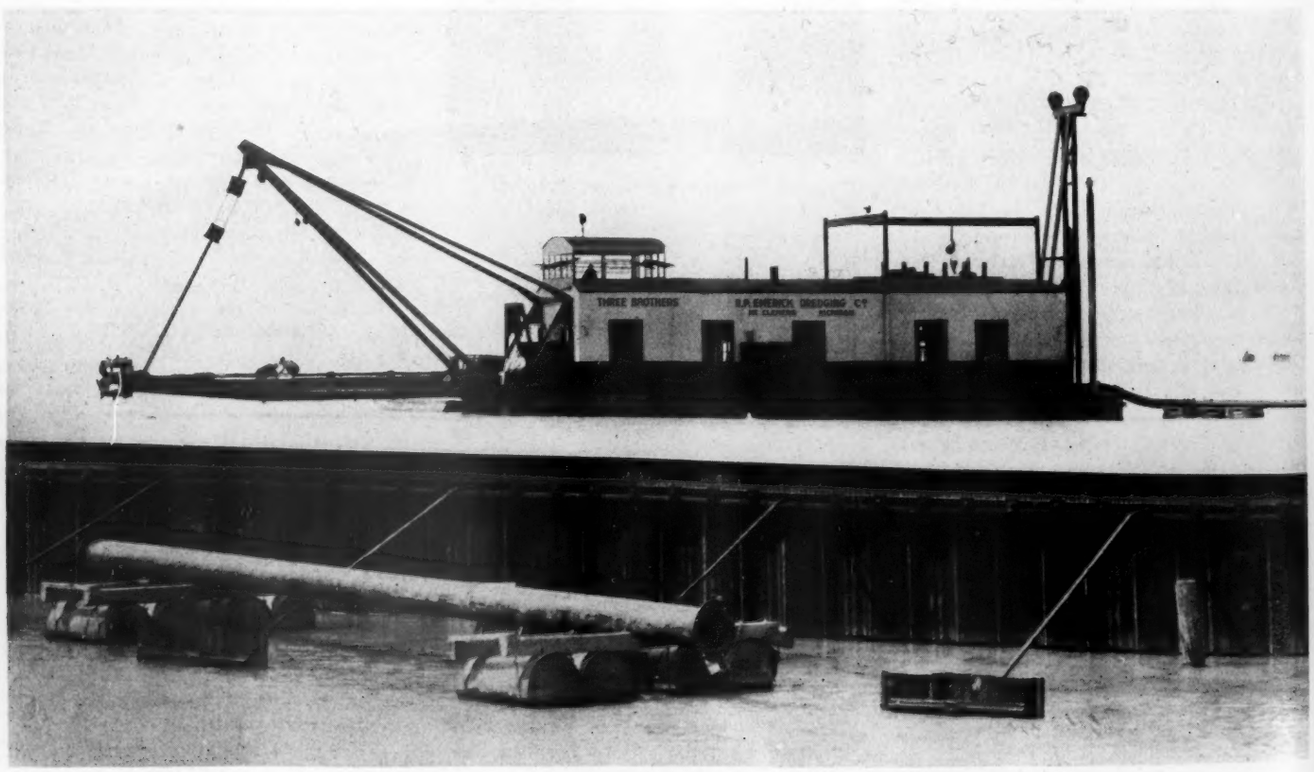
Power Plant

The dredge pump is individually powered by a Fairbanks-Morse 360-hp., model 32, style VA, Diesel engine of 257 r.p.m. A variable-speed throttle control gives flexibility over a wide range of pump operating speeds. The accompanying illustration of the interior of the cabin shows the controls and clearly outlines the hull discharge pipe line and its proximity to the center of the aft gunwale, designed to minimize whipping action in the pontoon pipe line as the dredge swings on its spuds. A 12-in. Amsco flap valve of enclosed design is placed next to the pump discharge opening.

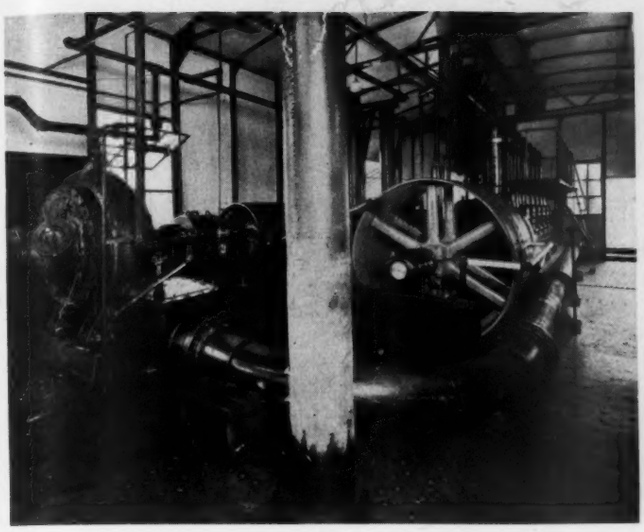
All auxiliary equipment, hoist, cutter and water pumps, is driven individually by electric motors, using direct current of 125 volts. Current is furnished by a Fairbanks-Morse, model 41, marine type Diesel engine and a 120-kw. generator set. This unit operates at 480 r.p.m., and the generator is the 40 deg. C. continuous duty design. The Diesel engine generator set is placed on the deck opposite the dredge pump to provide proper weight distribution.

For lighting, an auxiliary Diesel engine generator unit of Fairbanks-Morse, style H, 1500 watts output at 115 volts is used.

The two large Diesel engines are provided with heat exchanges. Raw-water circulation is pumped by a single-stage, 4-in. suction, 3-in. discharge, centrifugal water pump, direct connected to a 3-hp. motor. The dredge pump engine circulates sweet-water with the use of a single-stage, 2½-in. suction, 2-in. discharge, centrifugal pump driven from the fly-wheel of the engine. The generator set engine circulates sweet-water from a pump built into the engine assembly.



Dredge "Three Brothers" with rotary cutter ladder in raised position



Two views of the 12-in. pump with its drive and Diesel engine beyond

For the dredge pump water service, priming, shaft stuffing box seal, thrust bearing cooling, and for fire protection and general dredge utility, a 2-stage, 4-in. suction, 3-in. discharge, centrifugal pump, direct connected to a 15-hp. motor of 1150 r.p.m. is used.

The hoist is a Mundy 5-drum design powered by a 20-hp. General Electric, type CD, 1150 r.p.m. motor. The drums are 14 in. in diameter and ⅝-in. diameter wire rope is used for all service lines.

The ladder is of Bates Engineering Works design, 45 ft. long and mounted with trunnion hinges on the front gunwale deck edge of the hull. The cutter is of Bucyrus design, with six blades of the basket type of construction, with teeth mounted on the blades. The cutter size is 4 ft. 8 in. back ring diameter and has a maximum speed of 15 r.p.m. The cutter is powered by a 75-hp. Fairbanks-Morse motor provided with Cutler-Hammer controls for speed regulation.

Hull Construction

The hull size is 80 ft. over all, 32 ft. wide by 6 ft. depth. In the deck plan the front corners of the hull do not form a rectangle. The front gunwale is 22 ft. wide, and the forward portions of the side gunwales slope back for a distance of 15 ft. from the front gunwale, after which position the full hull width of 32 ft. is maintained. This bow relief, or champfering of the forward corners, permits maximum ladder swing without hull interference. Four fore and aft, water-tight bulkheads of plate girder type are used. Thwartships six similar bulkheads are used. The hull construction provides 24 water-tight compartments and is designed for maximum strength. The bottom is of ⅜-in. plate and the gunwales, decking and bulkheads are of ¼-in. plate. All connections are double gun riveted with the seams caulked. Both ends have slight rakes for towing convenience. The side gunwales are protected with heavy timber rubbing streaks.

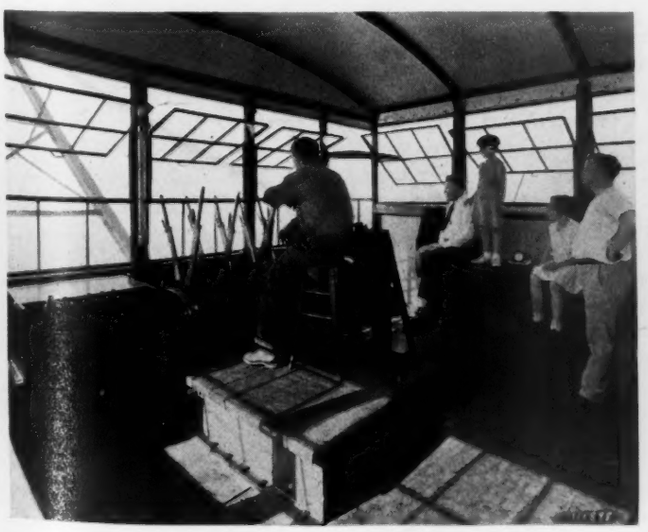
The cabin is 64 ft. long, 24 ft. wide and 13 ft. high from the deck to the eaves. The front wall is set back 10 ft. from the front gunwale, giving 6 ft. walkway aft. The side walkways are each 4 ft. wide. The roof is curved. Thin steel plate is used for siding and roofing. Steel doors and window sash are employed throughout. The pilot house is placed forward and on the roof plane of the main cabin to provide the operator with full, clear vision of the entire operation.

The legs of the A-frame are 10-in. H-beams and other members are 6-in. heavy angle construction. The entire structure is framed integrally with the hull fabrication to give maximum strength.

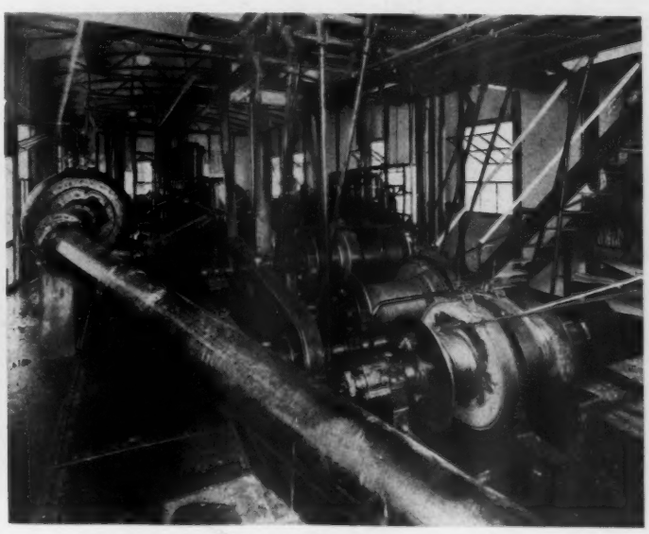
The spuds are round, 14½ in. outside diameter, and are made of 1¼-in. steel, 40 ft. long, supported by a steel gallows frame.

The dredge has an output of 250 to 300 cu. yd. per hour in hard digging.

The *Three Brothers* was designed and constructed under the supervision of R. P. Emerick, president of the company, and represents many years' dredging experience. Perry I. Nagle of the pump department of the American Manganese Steel Co. contributed to the design and aided in the selection of equipment. The dredge was built by the Yeager Bridge Co., Port Huron, Mich.



Pilot house containing controls



Hoist in foreground and pump beyond

Dry Quenching Applied to the Cement and Lime Industries

By A. B. Wolle
New York, N. Y.

THE USE OF HEAT in process work for the transformation of raw materials into a finished or semi-finished state is only as efficient as the extent of the utilization of the heat supplied. The heat remaining in the product discharged has a value when its reclamation cost is considerably less than the cost of the heat in its original form. The efficiency of this reclamation of the sensible heat (potential heat) in the product falls off rapidly as the amount to be reclaimed diminishes. It is therefore necessary to consider carefully all facts concerned in securing the most economic heat recovery.

It is with a desire to indicate to the cement and lime industries the manner and efficiency with which the heat now lost may be secured through the adoption of the dry cooling process, that this article is written. This process has been successfully applied to the byproduct coke industry in Europe for the past 15 years, and for over 5 years in the United States, for the recovery of the sensible heat remaining in the coke after it is discharged from the coking ovens, without any deteriorating effect upon the coke so treated. From the comprehensive surveys made in the foregoing industry and from the data presented in this article it will be evident that the process of dry quenching, or cooling, is readily adaptable to the cement and lime industries for the recovery of a major portion of the heat in the product. Furthermore, the efficiency of heat recovery by dry quenching is higher than that of other methods in common use at this time.

In some instances the dry quenching process may involve a higher original investment cost than the equipment now in use, but a close comparison of the processes will show the former to be more flexible of adaptation and a more efficient as well as a more diversified method of heat recovery. The heat recovered may be secured in two forms; high temperature air; steam at pressures and temperatures commensurate with plant conditions; or, a combination of both. The heat remaining in the product after quenching may be reduced to within a small margin above the surrounding atmosphere in that class of material that is non-oxidizing and is not apt to react with the atmospheric moisture.

The operation of the dry quenching equipment is extremely simple. As there is a minimum of moving parts, an operator is not required in most instances, unless steam is produced, and then there is need for only a portion of the time of the water tender who is delegated to the attention of the waste heat boilers in the vicinity. Automatic handling equipment electrically interlocked and controlled further facilitates operation and goes far to eliminate the human factor in operating the equipment.

Fundamentally, the dry quenching or dry cooling process consists of passing a stream of air (inert gases in the handling of oxidizable material) through the hot material that is in granular form. During the contact of this air, or gas, with the material being cooled, heat is transferred from the material to the gas, which leaves the mass at a relatively high temperature and then passes through a heat exchanging device where the heat is transferred to a usable form such as high-temperature air or steam. This scheme has all the important advantages of counterflow of the material and the cooling gas.

Regardless of the construction of the dry cooling unit, certain fundamental elements are employed, about which the plant is evolved. First, there is the container, a receptacle for holding the charges of material to be cooled; second, the heat exchanger for recuperating the heat of the material; and, third, a fan that circulates the cooling gas between the container and the heat exchanger. When this equipment is used for cooling a material that is subject to oxidation, the operation of the charging and discharging doors is so arranged that air is not admitted to the system during either of these operations. In all cases before a charge is placed in the container, an equivalent amount of material is withdrawn so that the average height of the material is maintained at a constant level. The heat is given up continuously to the cooling medium, as the circulating fan is not stopped for the charging or discharging operations. Units of this type can be designed for serving either a single kiln or a battery of kilns, and can be designed for any capacity desired, as automatic equipment is extensively used to insure simplicity of operation. The hot material is picked up at the discharge point of the kilns and after passing through the cooling unit can be returned to the original cooling pit or conveyed to any other point without rehandling.

It is evident to every manufacturer of cement, lime or similar product that the heat being dissipated to the atmosphere in the cooling beds represents a sizable portion of the heat put into the kiln in the form of coal. For example, in a cement plant operating under extremely efficient conditions and discharging clinker at approximately 2030 deg. F., the heat lost represented approximately 10% of the total heat used. To illustrate this statement more clearly, the quantity of heat available for recuperation can be ascertained from the charts in Fig. 1 and Fig. 2, wherein the heat contents are based upon experimental data that can be considered as very close to actual conditions. Fig. 1 represents the heat content of cement clinker at various temperatures. The heat content of burnt lime is similarly represented in Fig. 2. It is evident from a study of these charts that a considerable quantity of heat is available for conversion into useful energy.

Assume, for instance, that a plant pro-

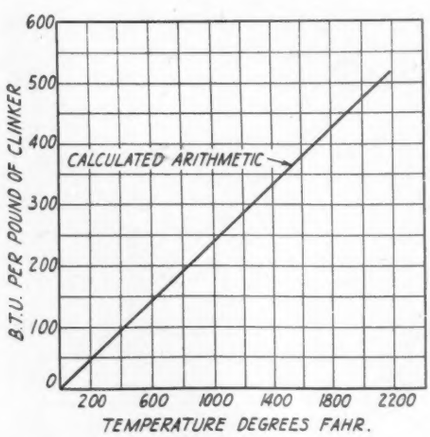


Fig. 1. Heat content of cement clinker determined from experimental data

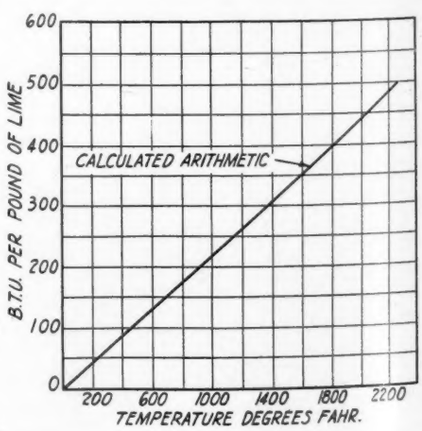


Fig. 2. Heat content of calcined lime rock determined from experimental data

duces 3000 bbl. of clinker per day with a coal consumption of 100 lb. per bbl. of a 12,000 B.t.u. coal and that the clinker is discharged from the kiln at 2050 deg. F. From the chart in Fig. 1 the heat discharged with the clinker would be equivalent to 22 tons of coal per day, or a heat loss of 14.6%. However, should this clinker be passed through a dry cooling unit and discharged at 250 deg. F., 90% of the heat would be available as useful energy, resulting in a loss of only 2.2 tons of coal instead of 22 tons.

Applies Equally to Lime

Virtually the same conditions exist in the lime plant, except that the quantity of heat wasted is slightly smaller. Nevertheless, the efficiency of recuperation remains the same. Recovery of this sensible heat is entirely practicable as indicated by experimental data and by the results obtained in the by-product coke industry. Due to the fact that the structure of both the cement and lime pieces is more homogeneous than that of coke, it is quite natural to expect that the movement of the heat from the center to the surface of the pieces will be slower. This condition offers no particular difficulty to the cooling process. It means a longer time of contact between the pieces and the heat transferring medium than would be required with a less homogeneous structure, which in terms of plant construction means a larger quantity of material in the container per unit of output. This greater mass of material would effect a higher static pressure drop through the cooling bed, which in turn would increase the power required to operate the fan. The cost of this power represents the principal cost of this process aside from the original investment. The maintenance cost of the equipment is low, since there are practically no moving parts except the hoist and the fan. The hoist is constructed to resist abrasion and distortion by the hot material; the fan can be arranged to draw air from some dust-free location, thus preventing abrasive action upon it.

The heat liberated by the product may be secured in two ways; first, steam at pressure and superheat to meet plant conditions; second, as high temperature air approaching 1500 deg. F. A combination of these two methods may be effected by employing a boiler to absorb the major portion of the heat and an air heater to recover the remainder by raising the temperature of the combustion air at the kilns. For any given capacity there is a definite amount of heat liberated per unit of time, and the quantity of steam produced as well as the quantity and temperature of the air preheated may be varied to meet the operating conditions of the cement or lime plant. For example, on a 3000-bbl. per day basis there could be produced 13,800 lb. of steam at 200-lb. pressure and 150 deg. of superheat from feed water at 212 deg. F., as well as 21,300 cu. ft. of air preheated from 70 deg. to 350 deg. F. At the sacrince of the steam volume to 11,500 lb. per hour, 24,600 cu. ft. of air could be preheated to 550 deg. F. It is evident, then, that the system is extremely flexible and that in the combined form practically any combination of conditions can be secured that will produce the most satisfactory operating results.

There was a misconception at one time in the cement industry which fathered the idea that in order to insure good results it was necessary to allow a certain aging of the clinker before grinding. With the passing of this erroneous hypothesis it becomes evident that aside from cooling of the clinker the stock pile is unnecessary, providing, of course, that it is not required for storage. The stock pile takes up room that could be used to advantage for other purposes and requires unnecessary handling of the material. It is definitely known that clinker above 200 deg. F. does not grind as readily as clinker of a lower temperature, the higher temperatures affecting the output of the pulverizers as much as 40%. Obviously, it is desirable to eliminate: the raw stock pile; the use of cooling water; the handling of the hot clinkers; and the limitations set on mill capacity by hot grinding. This may be accomplished by employing the dry quenching process for this purpose, making the recuperation of the heat an incident to the betterment of operating conditions. It is understood, for example, that if the clinker discharged from the kilns was a precooled product it would be run directly upon a belt conveyor and so to the storage bins at the pulverizers. No one would consider dumping it into pits and subsequently spreading it out over a large area, only to gather it up again to send it to the pulverizers. It appears logical, therefore, eliminating these necessary handlings of a hot material would create a considerable saving in time, equipment, its maintenance, and labor. This is exactly what a well designed cooling unit will accomplish by taking the hot material directly from the kilns and removing the heat, discharging it upon a belt conveyor or other means of handling by which it may be carried directly to the pulverizer house.

Savings from Heat Recuperation

The life of this unit is virtually the life of the boiler, which is well beyond 15 years. Under these circumstances it would be wise to amortize the original investment over this period of years and so secure a sizable reduction in plant operation each year. The following tabulation represents an economic setup for a plant producing 3000 bbl. per day, the recuperated heat from which is represented in part by steam at 200 lb. pressure and 150 deg. superheat. Air is also preheated to 350 deg. F. for combustion purposes. The costs of maintenance and power are hypothetical values based upon reliable figures from the byproduct coke industry, these figures having purposely been exaggerated to insure a wide margin of safety.

Gross Return

Steam actually produced per 24 hours, 331,000 lb.	
Value of this steam per day at 40c. per 1000 lb. $331 \times 40 =$	$132
Reduction of coal consumption per bbl. by use of preheated air. Coal at $4.50 per ton and 100 lb. per bbl. Saving at 4%, $\frac{3000 \times 100}{2000} \times \$4.50 \times 0.04 =$	27
Total daily income	$159

Operating Costs

Maintenance at ½c. per bbl. of clinker handled. $3000 \times \$0.005 =$	$ 15
Power for operating two fans and hoist at 1 kw.-hr. per bbl. and 1c. per kw.-hr. $3000 \times 1 \times 0.01 =$	30
No additional labor required for operating the unit	.....
Total daily operating costs	$ 45

Return on Investment, Annual Basis

It is assumed that the entire production will be sent through one unit and that the cost of this unit installed ready for operation will be approximately $125,000.

Taking 8% to cover fixed charges, this item will be each year	$10,000
Annual cost of operation, 45×350 days	15,800
Total operating costs per year	$25,800
Return from value of steam and preheated air. 159×350 days	$55,600
Deducting annual operating costs	25,800
Return each year	$29,800

This amount applied to the original investment, $125,000, divided by $29,800, would amortize it in 4.2 years, representing a return on the investment of 24%.

However, since the life of the unit is well beyond 15 years, this time may be used for its amortization and a benefit gained each year through a reduction in operating costs in the following manner:

Amortization each year. $125,000 \div 15$	$ 8,340
Operating charges each year	15,800
Interest at 8% as above (fixed charges)	10,000
Total annual cost	$34,140
Gross annual saving to be expected	55,600
Less total annual costs	34,140
Annual reduction in operating costs	$21,460

It is clearly evident from the above figures that a substantial saving can be secured in the operation of a cement plant through the recuperation of the heat in the clinker. These values are substantially the same for a lime plant, as the specific heats in both cases are practically identical and the difference existing is not sufficient to alter these values appreciably. The return on the investment here is based upon only two known factors: the steam; and the air for firing. In addition to these values, other possible economies exist which may be classified under the head of hidden and intangible benefits, such as: elimination of wetting the hot clinker; abso-

lute certainty of clinker temperature for grinding; and better handling facilities, etc. What they mean to the individual plant operator depends upon both his foresight and his comprehension of the conditions at hand.

These cooling units are extremely dependable in operation and will produce a constant flow of steam so long as the supply of hot material is not interfered with. Hence, it would be practical to generate electric current with the steam so produced, providing it was in excess of plant needs. For example, in the plant previously outlined, assuming that all steam could be diverted to electrical generation, and that it supplied a turbo-generator which had a water rate of 18.5 lb. per kw.-hr., there would be produced 750 kw. per hour per day. Valuing this power at 1c. per kw.-hr., the annual value of the current so produced would be $63,000 per year of 350 working days, no credit being taken for the exhaust steam or deductions made for investment and maintenance charges.

For a clearer understanding of the dry quenching system and the operation of the component parts, a diagrammatic layout is shown in Fig. 3. The heat recovered is used for the production of steam and for preheating a portion of the combustion air used at the kilns. The path of the material through the dry quencher is shown by the heavy arrows. It is discharged directly to the bucket of the hoist from the receiving hopper located under the kilns. This hopper serves only to insure against spillage while the hoist bucket is not in the receiving position.

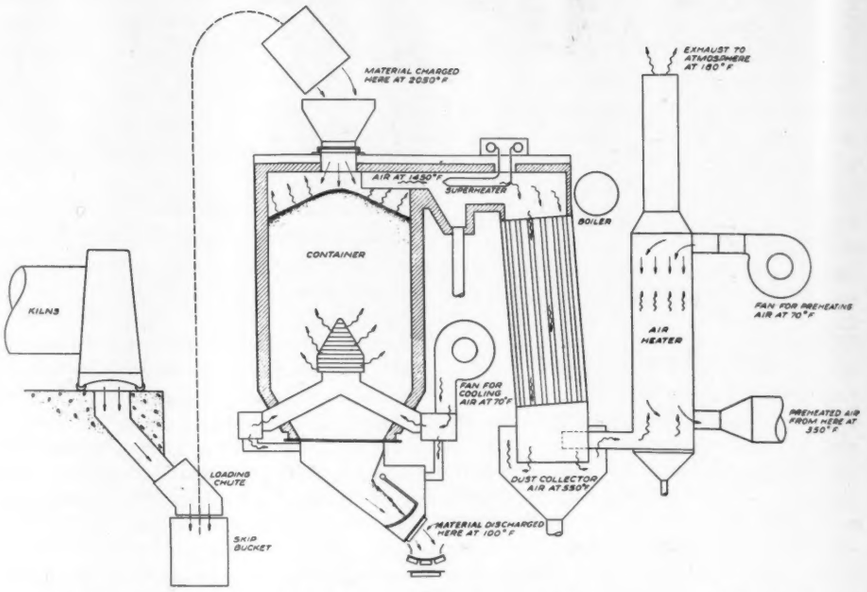


Fig. 3. Dry cooling unit for such materials as lime or cement clinker. The temperatures are comparative only

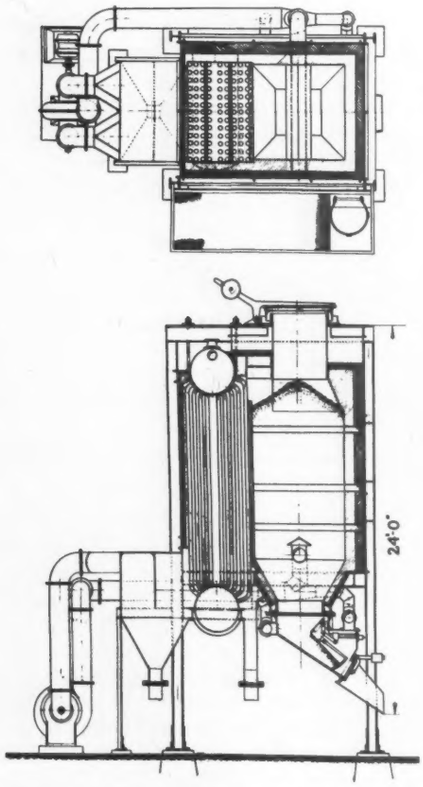


Fig. 4. Dry cooling unit for small kilns. Air preheater may be substituted for boiler or air may be fed direct to kiln at high temperature

The path taken by the air as it transfers the heat from the hot material to both the boiler and air heater is shown by the wavy arrows, while the preheated air is readily discernible by the markings. For the sake of clarity, the cooling air is shown discharged to the atmosphere at 180 deg. F. In actual practice it would be returned to the container, and on this condition the foregoing figures are based. The temperatures given for both the cooling air and the preheated air are based upon an entering temperature of the material of 2050 deg. F. When higher temperatures are desirable, it is entirely practicable to eliminate the air heater and to direct the hot air leaving the boiler directly to the kilns. With such an arrangement means might be required to precipitate the entrained dust carried out by the blast as it leaves the container. This can be readily accomplished and at a minimum of investment cost. When steam is produced in excess of demand it may be used for operating the circulating fans through turbine drives at the cost of the feed water and condensing water. There are a variety of ways of securing the heat and benefits of dry quenching at an extremely nominal cost, so much so that it is well worth considering in connection with either a cement plant or lime plant, regardless of their daily capacity. For the smaller daily capacities other types of units are designed which, due to the small ground space they occupy, may be easily adapted to existing conditions, and in some instances the skip hoist can be eliminated, discharging the clinker directly into the cooling unit. In these small units, as well as the large ones, the efficiency of recuperation is high, and they may, too, be used for producing either steam, high temperature air, or a combination of both. Fig. 4 represents one of these small units adapted for producing steam only, transferring 95% of the heat so secured into steam at any pressure desired.

Since there are no installations of this kind in the United States, it is natural to approach the subject with some apprehension, just as the byproduct coke industry did, only to see its worst fears dissolved. It will take some energetic individual with keen vision to make the first step forward, and he will not be disappointed with the results obtained, because the process of dry quenching is far removed from the experimental stage and the performance data available insures its satisfactory operation with other products as well as with those peculiar to the coke industry.

Four Killed by Rock Slide in Quarry

E. T. WALKER, 44, owner of the Limestone Service Co., Centerville, Ohio, and two employes, James Wilcher, 23, and John Ratliff, 32 were crushed to death and Elwood Brackett, 24, was fatally injured on March 15 in a cave-in at the company's quarry. Three of the four men were completely buried by the falling rock.

Mr. Walker has owned and operated the quarry for several years; coming to Centerville from New York state. He has been operating an extra force to fill orders.

The men had done considerable blasting during the morning, but had worked during the afternoon in loading trucks to convey the rock to the crusher.

As a truck was being backed to an overhanging ledge it crumbled without warning.

Mr. Walker had been in the stone quarry business for 24 years, relatives said. He had owned the Centerville plant for the last six years.—*Dayton* (Ohio) *Herald.*

Develops Insulation Material from Waste Rock and Slag

IN KEEPING with modern progress in the utilization of waste materials, the Eagle-Picher Lead Co. has developed and is marketing nationally, insulation material made from their Joplin, Mo., chat piles and lead blast furnace slags.

These materials mixed in proper proportions with pure limestone are fused with coke in a blast furnace. The molten slag is drawn past a tuyere blowing live steam. The resultant product is a dark gray colored soft wool which is collected in a large receiving chamber on push cars. A natural segregation of the wool, according to size and length of fiber, is obtained in this chamber. This wool differs greatly from the more familiar rock or slag wools, due to its soft flexible fibers, and freeness from the sharp glassy-like particles that are so annoying to those handling the material.

This wool is then manufactured into various types of heat insulation, such as blankets, pipe covering, insulating cement and home insulation. In accordance with the U. S. Bureau of Standards' tests, the thermal conductivity is only about one-half that of "85% magnesia" insulation. It is efficient at high temperatures as well as at low temperatures. giving the product a wide range of application. The remarkable low conductivity and lightness in weight insures an ideal insulation.

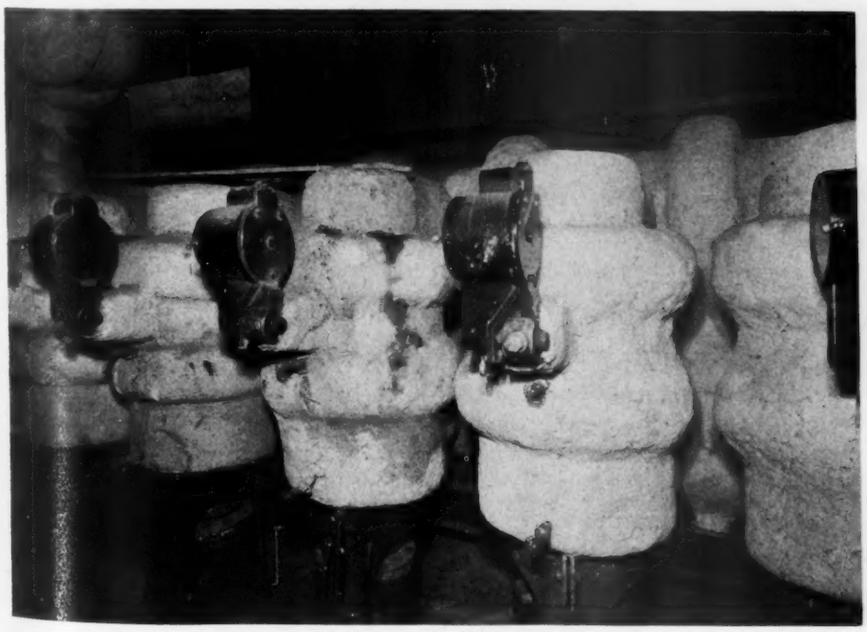
The wool blankets contained between expanded metal lathe of copper bearing iron are used extensively for insulating boiler walls, boilers, tanks and oil refinery towers or stills. The insulating cement is used for insulating flanges, valves, tees, elbows and all irregular surfaces where it would be difficult to apply the blanket or pipe covering. The home insulation is a fine granulated wool which is pneumatically placed into the side walls and ceilings of homes or buildings. A house or building insulated in this way will be 10 to 15 deg. cooler than the outside temperature on a hot summer day; it will require from 30 to 50% less fuel to heat this building in the winter, it is claimed.

Award $1,000,000 Contract for Potash Plant

THE CONTRACT for constructing the first potash refining plant of any magnitude in this country has been awarded at Loving, N. M., by the United States Potash Co. The plant will cost approximately $1,000,000. The buildings are to be of structural steel and concrete. As a part of the equipment there will be two steam turbines, each of 12,000 hp. The refinery will be connected with the company's potash deposits by a 12-mile railroad. The mining of potash is well underway and approximately 2000 tons of the raw product are being shipped monthly. When the refinery is ready for operation, which will be by September 1, production will be vastly increased. The company is affiliated with the Monolith Portland Cement Co.—*Wall Street* (N. Y.) *Journal.*

To Build New Dredge

THE 175-horsepower gravel dredge belonging to the Handsboro Gravel Co., Gulfport, Miss., which has been operating at Handsboro for several months, sank in 20 ft. of water recently, and efforts are being made to raise the vessel. Paul Bonham, one of the owners, stated that the dredge was so badly damaged that it could not be salvaged and that a new dredge would be built.—*Mobile* (Ala.) *Register.*



Example of use of insulating cement

Increase Capacity of California Quarry

THE Kaweah Quarries, Inc., three miles north of Lemon Cove, Calif., will be reopened soon, when the manufacture of highway materials will be started by a group of San Francisco men. They have taken over the plant and expect to invest $1,250,000 in a new plant, according to A. C. Root, who has operated the quarries for the past 15 years.

Workmen are busy now placing the present equipment in condition for use and installing new machinery. A new rock crusher will be installed. When all the machinery is installed, the plant will be capable of producing 1000 tons of crushed rock a day. Tracks are being laid to handle 20 cars

A number of state contracts for the delivery of the crushed rock have already been received it is reported.—*Fresno* (Calif.) *Republican.*

Multiple V-Belt Patent Suit Settled

THE Allis-Chalmers Manufacturing Co. announces that the suit between it and the Dayton Rubber Manufacturing Co. of Dayton, Ohio, in United States district court at Cincinnati, Ohio, involving patent infringement of Allis-Chalmers Geist patent No. 1,662,511, pertaining to multiple V-belt drives has been settled out of court. The Dayton Rubber Manufacturing Co. takes a license under the Geist patent and the Allis-Chalmers Manufacturing Co. has the right to operate under Short patent No. 1,538,303 if it so desires.

Starts New Plant in Arkansas

THE Washed Sand and Gravel Co. is erecting a plant at Laird, Ark., for producing washed and screened gravel for concrete construction.

The railroad is already in from Laird, to the plant location and most of the machinery and equipment is on the ground. Scrubbers, screens and classifiers are to be purchased to complete a modern plant. The water supply for scrubbing is abundant.

Tom B. Laird, general manager, says the plant will have a daily minimum capacity of 30 cars or 10 cars per 8-hr. shift.—*Jonesboro* (Ark.) *Sun.*

Increased Demand for Crushed Stone in Georgia

THE GEORGIA state department of forestry and geological development reports that due to the enlarged program of highway construction in the state, stone for road building purposes is in greater demand than ever before.

The annual output of crushed stone is now $750,000, the department reported, including small and large operations.—*Augusta* (Ga.) *Chronicle.*

New Machinery and Equipment

To Manufacture Excavating Equipment

THE CLYDE SALES CO., Duluth, Minn., announces it is now handling the distribution of equipment formerly manufactured by the Dayton Whirley Co.

In the past the Clyde Iron Works has manufactured the hoisting and swinging equipment of this line of shovels. Under the present arrangement the Clyde Iron Works will manufacture the complete units.

These machines will be available with three-drum engines for clamshell operation and will be furnished in six different sizes with either cable or gear swinging mechanism. They will also be built with two-drum engines.

Steam, gas or electric power will be optional on present equipment.

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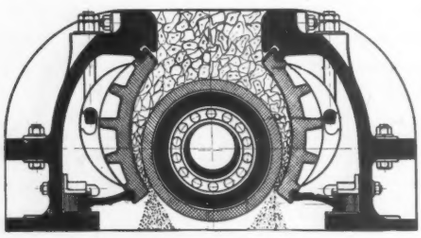
Improved Crusher

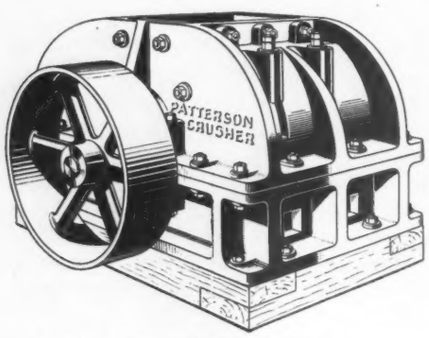
THE PATTERSON Foundry and Machine Co., East Liverpool, Ohio, announces the Patterson "Gyro-centric" crusher. This new crusher is an improved



Adjustable for wide production range

design of the Ohio crusher, formerly manufactured by the James H. Beans Foundry Co. which was described in the January 3, 1931, issue of ROCK PRODUCTS.

Improvements in this crusher include a heavier eccentric shaft of forged chrome nickel steel, safety device to protect breaker plates from damage by tramp iron, adjustable for wide range of sizes of production, vibration reduced, and larger roller bearings for carrying the cylindrical crushing roll.



Crusher has reinforced steel frame

Other features claimed for this crusher are production efficiency with double crushing action, three point Alemite lubrication system, and reversible concave crusher plates.

For ordinary work these crushers are furnished with a smooth roll and crushing plates. For "slabby" materials corrugated roll and crusher plates are furnished.

The "Gyro-centric" may be operated with either right or left hand rotation and is said to require a minimum of space.

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Thyratron Tubes Govern Speed of Spot Welding

CLOSE and accurate control of the frequency of current interruption in line welding, and an increase in speed of interruption up to 1800 per min., are among the advantages claimed for a new type of Thyratron tube timing control announced by the General Electric Co., Schenectady, N. Y. The new control replaces mechanical interrupters.

The new synchronous tube timer supplements, and is designed to work in conjunction with, the General Electric welding control type CR 7503, recently announced, which uses Thyratron tubes instead of contactors for interrupting the flow of current. By a combination of the two equipments, a very close degree of accuracy and a high welding speed are obtained, the manufacturer states.

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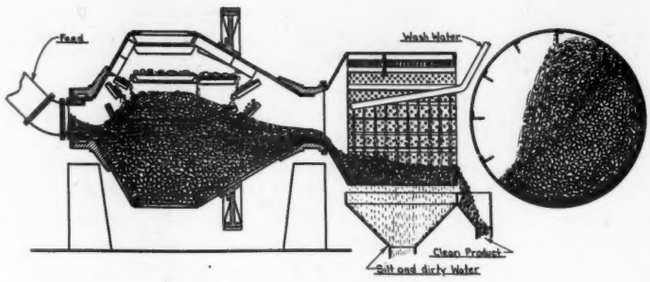
Conical Scrubber

THE Hardinge conical scrubber that is now finding application in washing crushed stone, as well as sand and gravel, is a large conical drum rotated on trunnion bearings. It is manufactured by the Hardinge Co., New York, N. Y. Feed enters at one end and is discharged at the other end into a revolving trommel screen. Only sufficient water to coat the sand and gravel is introduced at the feed end.



Washes stone, sand and gravel

As the drum revolves, the material within the scrubber is thoroughly mixed. According to the manufacturer, the weight of the mass and the rubbing action of the material against itself loosens the dirt and when the stone or gravel is discharged into the screen under a small stream of water it is rinsed clean of all clay and silt.

The scrubber is built in seven standard sizes, with a capacity range of 8 to 600 tons an hour. Advantages claimed for this scrubber are that there are no internal moving parts, no submerged bearings and no packing glands to maintain. Power costs are low and practically no operating attention is required, the manufacturer states.

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Kiln Mill

A NEW roller mill equipped with air separation and air drying to operate as a kiln mill is announced by Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

This new mill is said to provide a complete plant for handling powdered materials, as it feeds, grinds, drys, separates and conveys the product to storage. The manufacturer states the mill is both dustless and automatic.

Complete pulverizing plant

Since this mill dries as it grinds, it will operate on rock products and various materials that carry too much residual moisture for an ordinary mill without drying equipment to handle effectively. Thermostatic controls make possible regulation of the drying action.

Other features claimed for this new mill are the new Raymond oil journal, pneumatic feed control, concentrator collectors, improved fan arrangement and welded steel seams.

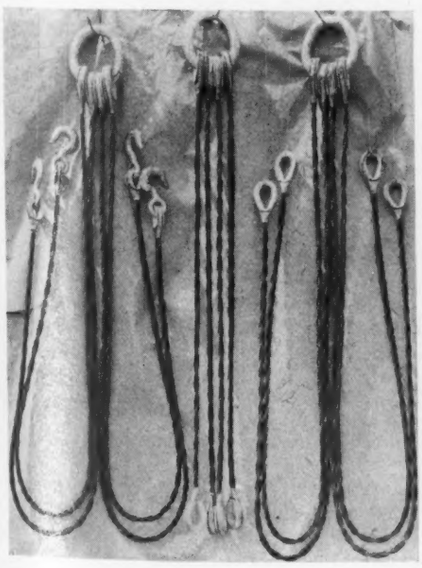
For pulverizing combustible substances a neutral gas may be introduced into the mill instead of air. A complete installation is shown in an accompanying illustration.

Slings for Handling Material

TWO NEW SLINGS of braided wire rope design have been announced by Macwhyte Co., Kenosha, Wis. The slings are claimed to have the strength of wire rope and the flexibility of chain. They are known as Macwhyte "Atlas" and Macwhyte "Drew."

The construction of the Macwhyte "Atlas" sling is entirely new and original in design. It has a round body and is composed of two endless elements of "Monarch Whyte Strand" wire rope, one left lay and one right lay, spirally interwoven by a method through which all the multiple parts are said to have the same degree of coaction and reaction to each other and assure adequate attachment to the sling fittings. Its structure provides a round sling body having a tendency to soften the rope lays when subjected to tension and assures a straight, non-spinning, highly flexible body throughout its term of service, the manufacturer states.

The Drew sling is composed of one endless element of "Monarch Whyte Strand" wire rope, braided to form a flexible, compact, flat surface, with a body approximately two cable diameters in thickness and six to 14 cable diameters in width, according to the number of parts employed.



Three types of slings

Its flexibility and ease of handling makes it particularly adapted to dimension stone work. In basket hitches, this endless element equally distributes the load through the entire sling from hook to hook.

The weight of these fabricated slings is approximately ¼ that of chain and, due to the absence of the proverbial "weakest link," their strength is said to be 60% greater.

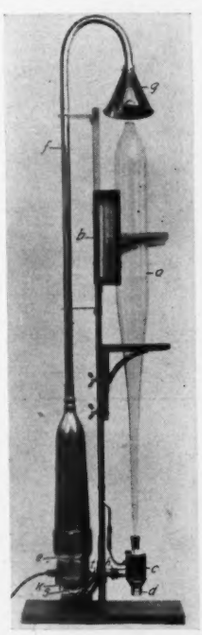
To Manufacture Equipment on West Coast

BLAW-KNOX CO., Pittsburgh, Penn., and the Western Pipe and Steel Co. of San Francisco and Los Angeles, Calif., have closed an agreement whereby Western Pipe and Steel will manufacture Blaw-Knox products on the Pacific Coast and will sell through the organization of a new company to be known as Blaw-Knox and Western Pipe Corp. This new concern will be equally owned by the two companies, it is stated.

Separator for Determining Cement Fineness

THE F L S separator, for analyzing fineness of cement and other finely ground materials, is announced by F. L. Smidth and Company, New York, N. Y.

It was developed to provide a practical means of analyzing particle size of cement and other materials not readily determined with wire screens.



Classifies finest particles

This apparatus consists of a large glass tube *a* connected to a small blower *e* which is arranged to blow an air current through a receiver *c* up through the glass tube.

In operating a fineness test on a small sample the blower is started and the air pressure, by means of a cock *h*, is adjusted to give a certain pre-determined pressure measured on the manometer *b*. The pressure selected depends in each case on the particle sizes at which the sifting is supposed to take place.

As soon as the correct pressure has been read on the manometer, a small weighed sample of cement is charged into the glass tube where the coarse particles are held in suspension by the air current while the particles finer than the particle size at which the separation takes place are carried out of the glass tube.

To avoid dust nuisance the fine particles are sucked into the funnel *g* and through pipe *f*, which passes into a filter bag and the filtered air is then blown back into the separator.

After about 25 min. operation the blower is stopped and the residue, consisting of the coarse particles only, drops down into a small detachable cup *d*. The cup is then removed and weighed.

With this separator it is possible to determine the percentage of particles 10, 20 and 30 microns in size in the cement, the manufacturer states.

Wire Rope

THE Broderick and Bascom Rope Co., St. Louis, Mo., announces its "Yellow Strand" wire rope is now manufactured with "Flex-Set" pre-formed construction.

In the manufacture of this rope the wires and strands are shaped to the form they will occupy when laid up into the rope.

Advantages claimed for this new rope are that it handles and spools easily and that it has longer life under almost every operating condition.

Splicing is also said to be easier with "Flex-Set" pre-formed wire rope and external and internal wear reduced.

Portable Flight Conveyor

A BITUMINOUS TYPE of portable flight conveyor is announced by the Link-Belt Co., Chicago, Ill. It is also adapted to handling bituminous coal, coke, and other lumpy materials, as well as fines.

It is made in lengths of 21-, 26-, and 31-ft. centers with capacities of from 60 to 90 tons of coal per hour, depending on length of machine.

The carrier is made of two strands of C-188 malleable iron and steel combination chain to which flights are fastened every 15¾ in. The trough is made of copper bearing steel.

Ball bearing motors provide the power. The motor is also arranged to operate the hoisting mechanism.

The minimum discharge height of the conveyors above the ground line is 8 ft.; the maximum discharge heights are 14 ft., 17 ft. 6 in. and 20 ft. 6 in. for the 21, 26 and 31 ft. conveyors, respectively.

Motor operates hoist

Current Prices of Ready-Mix Concrete

AMARILLO, TEX.—Prices per cu. yd.*

Lime Mortar

Mix	
1–4	6.50
1–4½	6.25
1–5	6.00

Terrazzo

Mix	
1–3 –0	9.75
1–3½–0	9.25
1–4 –0	8.75
1–4½–0	8.50
1–5 –0	8.25

Topping

Mix	
1–1 –0	13.75
1–1½–0	12.75
1–2 –0	11.75
1–2½–0	11.25
1–3 –0	10.75
1–3½–0	10.25

Base—Strength

4000 lb. per sq. in.	9.75
3500 lb. per sq. in.	9.25
3000 lb. per sq. in.	9.00
2500 lb. per sq. in.	8.75
2000 lb. per sq. in.	8.50
1500 lb. per sq. in.	8.25

Base

Mix	
1–2 –3½	9.25
1–2¼–4	9.00
1–3½–4½	8.00
1–3 –5	8.00
1–4 –6	7.25

*For orders of 50 cu. yd. or more, prices are 75c less per cu. yd. than quoted. Free delivery within city limits for 2 cu. yd. or more per load; $1.00 per load extra for less than 2 cu. yd. loads, except to finish a job. Additional charge of 10c per mile per cu. yd. for deliveries outside of city limits.

BELLINGHAM, WASH.—Prices per cu. yd.¶

Mix	Retail, f.o.b. bunkers	In carloads
1–3–4	6.85	6.10
1–3–5	6.51	5.75
1–2–3	7.85	6.91
1–2–4	7.27	6.50

¶Additional charges for delivery to various zones. First zone, added charge of 75c per cu. yd.; second zone, added charge of $1.05; third zone, added charge of $1.40; fourth zone, added charge of $1.75.

BOSTON AND CAMBRIDGE, MASS.—Price per cu. yd. for orders of 30 cu. yd. and over.‡

Mix	
1–2 –4	7.25
1–3 –6	6.75
1–2½–5	7.00
1–2 –3	7.70
1–1½–3	7.80
1–1 –2	8.55
1–2	10.25

‡Discount of 50c per cu. yd. allowed on deliveries made between the 1st and 15th of the month if bill is paid on or before the 25th and on deliveries made between 15th and 30th if paid on or before the 10th of following month.

CHAMPAIGN, ILL.†—Prices per ton (weight, 4000 lb. per cu. yd.)

Mix	
1–2–3	5.25
1–3–5	4.50
1–2–4	4.75

†5% trade discount to contractors. Prices to both contractor and consumer subject to cash discount of 5% for payment by 10th of month following del. For quick strength concrete, 1–2–3 mix, extra charge of $1.50 per ton; 1–2–4 mix, $1 per ton extra. Added charge of 25c per ton for the use of chloride, lime or Celite in any wet mix. For heating concrete, 12½c extra per ton. For topping, any mix, $1.35 for each sack of cement used.

COLUMBUS, OHIO—Delivered prices per cu. yd.

Mix	Zones§ 1	2	3	4	5	6	7	8	9	10
1–1½–3	6.05	6.20	6.35	6.50	6.65	6.80	6.95	7.10	7.25	7.40
1–2 –3	5.80	5.95	6.10	6.25	6.40	6.55	6.70	6.85	7.00	7.15
1–2 –3½	5.60	5.75	5.90	6.05	6.20	6.35	6.50	6.65	6.80	6.95
1–2 –4	5.40	5.55	5.70	5.85	6.00	6.15	6.30	6.45	6.60	6.75
1–2½–4	5.25	5.40	5.55	5.70	5.85	6.00	6.15	6.30	6.45	6.60
1–3 –4	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35	6.50
1–2½–5	5.00	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35
1–3 –5	4.90	5.05	5.20	5.35	5.50	5.65	5.80	5.95	6.10	6.25
1–3 –6	4.75	4.90	5.05	5.20	5.35	5.50	5.65	5.80	5.95	6.10
1–4 –8	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85
1–2	7.45	7.60	7.75	7.90	8.05	8.20	8.35	8.50	8.65	8.80
1–3	6.60	6.75	6.90	7.05	7.20	7.35	7.50	7.65	7.80	7.95

§All zones radiating from center of city. Zone 1 is one mile in radius, zone 2 is two miles in radius, zone 3 is three miles in radius, etc. Discount of 25c per cu. yd. allowed for payment 10th of month following delivery date. For orders over 50 cu. yd. a deduction of 25c per cu. yd. is allowed. Orders of less than 2 cu. yd. carry same haul charge as 2 cu. yd. load. Orders for 2 cu. yd. or over delivered in full loads at 2 yd. or more.

DALLAS, TEX.†

Strength	Slump ½ in. to 1 in.	3 in. to 4 in.	6 in. to 7 in.
1500	5.25	5.45	5.85
2000	5.55	5.75	6.05

Strength	Slump ½ in. to 1 in.	3 in. to **4 in.**	6 in. to **7 in.**
2500	5.80	6.00	6.40
3000	6.15	6.55	6.75

Fixed Mixes (any slump)

1–2½–5	6.45	1–2–4	6.75
1–1½–3	7.45		

†Prices subject to 2% 15 days and are based on quantities of 50 to 999 cu. yd. and on delivery in 2½-cu. yd. loads within Zone 1, which extends about 1½ miles from either of two plants. Zone charges are approximately 10c per cu. yd. per mile beyond the Zone 1 limit. On quantities under 50 cu. yd. add 20c and on quantities over 1000 cu. yd. deduct 30c.

CLEVELAND, OHIO (a)—Prices per cu. yd. to contractors for orders of 2 cu. yd. or more.

Public Square basing point
Aggregate: Limestone

Mix	1st mile	2nd mile	3d mile (Maximum)
1–1 –2	7.50	7.75	8.00
1–2 –3	6.30	6.55	6.80
1–2 –4	6.00	6.25	6.50
1–2½–3½	6.00	6.25	6.50
1–2½–4	5.80	6.05	6.30
1–3 –4	5.70	5.95	6.20
1–2½–5	5.60	5.85	6.10
1–3 –5	5.50	5.75	6.00
1–3 –6	5.40	5.65	5.90
1–4 –8	5.25	5.50	5.75
1–2 Finish	7.50	7.75	8.00
1–2½ Finish	7.00	7.25	7.50
1–3 Finish	6.50	6.75	7.00

Basing point: Windfall Road and Broadway, Bedford, Ohio
Aggregate: Bedford gravel

Mix	Miles 1st	2nd	3rd	4th	5th	6th	7th*
1–1 –2	6.50	6.75	7.00	7.25	7.50	7.75	8.00
1–2 –3	5.30	5.55	5.80	6.05	6.30	6.55	6.80
1–2 –4	5.00	5.25	5.50	5.75	6.00	6.25	6.50
1–2½–3½	5.00	5.25	5.50	5.75	6.00	6.25	6.50
1–2½–4	4.80	5.05	5.30	5.55	5.80	6.05	6.30
1–3 –4	4.70	4.95	5.20	5.45	5.70	5.95	6.20
1–2½–5	4.60	4.85	5.10	5.35	5.60	5.85	6.10
1–3 –5	4.50	4.75	5.00	5.25	5.50	5.75	6.00
1–3 –6	4.40	4.65	4.90	5.15	5.40	5.65	5.90
1–4 –8	4.25	4.50	4.75	5.00	5.25	5.50	5.75
1–2 Finish	7.00	7.25	7.50	7.75	8.00*	.....	.....
1–2½ Finish	6.50	6.75	7.00	7.25	7.50*	.....	.....
1–3 Finish	6.00	6.25	6.50	6.75	7.00*	.....	.....

*Maximum.

(a) Industrials or consumers 50c more than contractors. Extra charge for concrete delivered nights, Sundays or holidays, $1.00 per cu. yd. over daytime schedule. For high-early-strength or waterproofing cements additional charge of $2.00 per cu. yd. For waterproof concrete using Anti-Hydro with manufacturer's guarantee, additional charge of $2.00 per cu. yd. For orders less than 2 cu. yd. add $1.00 per yd. to above prices. Prices quoted are based upon normal discharge of load within 20 minutes after arrival of truck. A demurrage charge of $1.00 for each 15 minutes thereafter.

DES MOINES, IOWA—Prices per cu. yd. (b)

(Made with ¾-in. gravel for structural work)

Mix	Slump	Plant price	Zone A	B	C	D
1–2½–5	2-in.	6.00	6.50	6.75	7.00	7.25
1–2½–5	6 in.	6.25	6.75	7.00	7.25	7.50
1–2 –4	2 in.	6.50	7.00	7.25	7.50	7.75
1–2 –4	6 in.	6.75	7.25	7.50	7.75	8.00
1–2 –3½	2 in.	7.00	7.50	7.75	8.00	8.25
1–2 –3½	6 in.	7.25	7.75	8.00	8.25	8.50
1–2½–3	2 in.	7.50	8.00	8.25	8.50	8.75
1–2½–3	6 in.	7.75	8.25	8.50	8.75	9.00

(Made with pea gravel for cellar and sidewalks)

Mix	Slump	Plant price	Zone A	B	C	D
1–2½–5	2 in.	5.75	6.25	6.50	6.75	7.00
1–2½–5	6 in.	6.00	6.50	6.75	7.00	7.25
1–2 –4	2 in.	6.25	6.75	7.00	7.25	7.50
1–2 –4	6 in.	6.50	7.00	7.25	7.50	7.75
1–2 –3½	2 in.	6.75	7.25	7.50	7.75	8.00
1–2 –3½	6 in.	7.00	7.50	7.75	8.00	8.25
1–2½–3	2 in.	7.25	7.75	8.00	8.25	8.50
1–2½–3	6 in.	7.50	8.00	8.25	8.50	8.75

(b) Discount of 50c per cu. yd. allowed on deliveries made between the 1st and 15th of the month if bill is paid before the 25th and on deliveries made between 16th and 30th if paid before the 10th of following month. Quick setting $2.00 per cu. yd. extra; waterproofing, $2.00 per cu. yd. extra. Each zone approximately one mile.

FAIRMONT, W. VA.—Prices per cu. yd. (c)

Mix	Quantity	Delivered	Called for
1–2–4	Less than 1 cu. yd.	11.00	10.00
1–2–4	From 1 to 4 cu. yd.	10.00	9.00
1–2–4	From 5 to 10 cu. yd.	9.50	8.50
1–2–4	From 11 to 49 cu. yd.	9.00	8.00
1–2–4	From 50 cu. yd. and up	8.50	7.50

(c) For 1–2–3 mix add 50c per cu. yd. to prices quoted; for 1–3–5 mix deduct 50c per cu. yd. from prices quoted.

INDIANAPOLIS, IND.—Prices per cu. yd. in small quantities, for delivery within 3-mile haul.

Mix	
1 bbl. cement/cu. yd. concrete	5.50
1¼ bbl. cement/cu. yd. concrete	6.00
1½ bbl. cement/cu. yd. concrete	6.30

LOS ANGELES, CALIF.¶—Prices per cu. yd.

Mix	1–5 yd.	5–25 yd.	25 or more	Mix	1–5 yd.	5–25 yd.	25 or more
3–50–50	8.25	7.25	6.25	1–2¾–3½	10.00	9.00	8.00
4–50–50	8.85	7.85	6.85	1–2 –4	9.85	8.85	7.85
1–3 –6	8.95	7.95	6.95	1–2½–3½	10.10	9.10	8.10
1–3 –5	8.95	7.95	6.95	1–2½–3¼	10.05	9.05	8.05
1–2½–5	9.50	8.50	7.50	1–2 –3	10.60	9.60	8.60
1–3 –4	9.75	8.75	7.75	1–2 –3½	10.20	9.20	8.20

¶Above prices for deliveries in Zone 1 (1-5 miles). Added charge of 75c per cu. yd. for deliveries in Zone 2 (5 to 10 miles). Added charge of $1.50 for Zone 3 (10 to 15 miles). Discount of 50c per cu. yd. if payment is made within 10 days from delivery.

MEMPHIS, TENN.—Prices per cu. yd. delivered in city.†

Strength	Portland	"Incor"	Strength	Portland	"Incor"
1800 lb.	6.50	7.30	3000 lb.	8.00	9.25
2000 lb.	7.00	8.00	3500 lb.	8.60	10.00
2500 lb.	7.50	8.50	4000 lb.	9.80	11.75

†Above prices based on gravel for aggregate. If stone is wanted for aggregate, additional charge of $1.00 per cu. yd. is made to above prices. 5% cash discount for payment 10th of month following date of invoice.

MILWAUKEE, WIS.—Prices per cu. yd. (e)

28-day breaking strength:	Per sq. in.	Slump 2 to 4 in.	Slump 4 to 6 in.	Slump 6 to 8 in.
Garage footings and walls	2000 lb.	4.50	4.75	5.00
Footings, floors, walls	3000 lb.	5.50	5.75	6.00
City paving	3300 lb.	4.75	.....	.....
Sidewalks, curbs	4000 lb.	5.75	6.00	6.25
24-hour high early strength	5000 lb.	7.00	7.50	8.00

Sold on old mixture method, 2- to 4-in. slump; 4- to 6-in. slump; 6- to 8-in. slump.

	Mix	
Walls—Garage footing	1–3–5	4.50
City paving	1–2–4	4.75
Garage floors, walls	1–3–3	5.50
Sidewalk	1–2–3	5.75
Special strength (machine bases)	1–1½–2½	7.00
Facing	1–3	8.00
Facing	1–2	10.00

(e) Discount of 25c per cu. yd. if paid by 10th of following month.

MONTGOMERY, ALA.—Prices per cu. yd. delivered in city limits. (g)

Mix		Mix	
1–2 –4	6.60	1–3–6	5.95
1–2½–5	6.20	1–2 mortar topping	11.50

(g) Discount of 25c per cu. yd. for payment in 30 days. Special quotations for quantity orders.

MORGANTOWN, W. VA.—Prices for jobs of 1 to 10 cu. yd., delivered (f)

Mix		Mix	
1–2–3	9.25	1–2½–4	8.65
1–2–4	8.75	1–2½–5	8.25

(f) Prices subject to cash discount of 25c per cu. yd. for payment 15 days from date of invoice.

NEW ORLEANS, LA. (h)—Plant prices per cu. yd. for 30 yd. or less.

Mix	Cement Portland	Cement "Incor"	Mix	Cement Portland	Cement "Incor"
1–4 –8	5.15	6.10	1–2–2	7.70	10.25
1–3 –6	5.75	7.00	2–3–6	8.05	10.55
1–3 –5	5.95	7.35	2–3–3	8.85	12.00
1–2½–5	6.25	7.80	1–1½ topping	10.95	15.80
1–2½–4	6.40	8.15	1–2 topping	9.30	13.25
1–2 –4	6.75	8.60	1–3 topping	7.85	10.85
1–2 –3	7.20	9.40			

Plant prices per cu. yd., 30 cu. yd. or over:

Mix	Cement Portland	Cement "Incor"	Mix	Cement Portland	Cement "Incor"
1–4 –8	4.65	5.45	1–2–2	6.95	9.15
1–3 –6	5.15	6.25	2–3–6	7.25	9.45
1–3 –5	5.35	6.55	2–3–3	8.00	10.70
1–2½–5	5.65	7.00	1–½ topping	9.85	14.10
1–2½–4	5.80	7.25	1–2 topping	8.40	11.80
1–2 –4	6.05	7.70	1–3 topping	7.05	9.60
1–2 –3	6.50	8.40			

(h) All prices subject to 5% 15 days, 30 days net. Haulage based on various zones.

NEWARK AND HARRISON, N. J.§

1–2 –4	6.50	1–3– 6	6.25
1–3 –5	6.00	1–2½–5	6.50

§Discount of 2% if paid by 10th of month following delivery.

NEW YORK CITY, N. Y.‡—Prices per cu. yd.

Manhattan and Bronx Mix		Queens Mix	
1–1½–3	10.00	1–1½–3	8.50
1–2 –4	9.25	1–2 –4	8.00
1–2½–5	8.75	1–2½–5	7.75
1–3 –6	8.25	1–3– 6	7.50

Westchester County (within radius of 7 miles)

1–1½–3	9.25	1–2½–5	8.00
1–2 –4	8.50	1–3 –6	7.50

Brooklyn

Mix	Under 50 cu. yd.	Over 50 cu. yd.	Mix	Under 50 cu. yd.	Over 50 cu. yd.
1–1½–3	9.50	8.50	1–2½–5	9.00	7.75
1–2 –4	9.25	8.00	1–3 –6	8.75	7.50

‡Special designed mixes on the strength basis priced according to the strength desired.

OMAHA, NEB.*—Prices per cu. yd. for quantities from 1 to 300 yd., delivered anywhere within the city.

28-day strength		28-day strength	
No. 1. 3500 lb. sq. in.	7.35	No. 3. 2500 lb. sq. in.	6.95
No. 2. 3000 lb. sq. in.	7.15	No. 4. 2000 lb. sq. in.	6.75

Transit-Mix Concrete

28-day strength		28-day strength	
No. 1. 3600 lb. sq. in.	7.50	No. 3. 2600 lb. sq. in.	7.10
No. 2. 3100 lb. sq. in.	7.30	No. 4. 2100 lb. sq. in.	6.90

*Sand-gravel mix used as aggregate. No. 1, 6 sacks cement per cu. yd. concrete; No. 2, 5½ sacks cement; No. 3, 5 sacks cement; No. 4, 4½ sacks cement. For high-early-strength concrete using "Quikard" or other supercement, add $2.50 per cu. yd.

PITTSBURGH, PENN.—Prices for ready-mixed concrete. Prices per cu. yd. delivered, up to 50 cu. yd. (j)

Mix	Strength		Mix	Strength	
1–1½–2½	4000 lb.	8.10	1–2½–4½	2500 lb.+	7.25
1–2 –3	3500 lb.+	7.75	1–2½–5	2500 lb.	7.10
Class A	3500 lb.	7.60	1–3 –5	2000 lb.	7.00
1–2½–3½	3000 lb.+	7.50	1–3 –6	1500 lb.	6.90
1–2 –4 Class B	3000 lb.	7.40			

Prices per cu. yd. delivered, over 50 cu. yd. (j)

Mix	Strength		Mix	Strength	
1–1½–2½	4000 lb.	7.10	1–2½–4½	2500 lb.+	6.25
1–2 –3	3500 lb.+	6.75	1–2½–5	2500 lb.	6.10
Class A	3500 lb.	6.60	1–3 –5	2000 lb.	6.00
1–2½–3½	3000 lb.+	6.50	1–3 –6	1500 lb.	5.90
1–2 –4 Class B	3000 lb.	6.40			

(j) Class A concrete is a special concrete prepared for the city of Pittsburgh. Plus indicates the strength shown is the minimum strength. Prices vary according to zones. Dealer's commission of 50c per cu. yd. allowed in all zones with exception of Yellow Zone. No commission allowed over 200 cu. yd. Prices subject to cash discount of 25c per cu. yd. for payment 15 days from date of invoice.

PUEBLO, COLO.—Prices per cu. yd.‖

Ready-Mixed Concrete

	Zone 1	Zone 2	Zone 3	Strength, 28-day test
Grade A	7.40	7.60	7.80	3000-lb.
Grade B	7.10	7.30	7.50	2700-lb.
Grade C	6.75	6.95	7.15	2400-lb.
Grade D	6.60	6.80	7.00	2100-lb.
Grade G	6.10	6.30	6.50	1500 lb.

Cement Mortar Mix	Zone 1	Zone 2	Zone 3	Mix	Zone 1	Zone 2	Zone 3
1–2	10.00	10.20	10.40	1–3	8.50	8.70	8.90

‖Deduct 50c per cu. yd. for orders of 10 yd. or more. For delivery outside of city, add 20c per mile beyond Zone 3.

ROCHESTER, N. Y.—Prices per cu. yd.

Mix	Plant price	Prices for delivery to various zones Zone 1	2	3	4	5	6	7
1–2 –3	7.00	7.75	7.90	8.05	8.20	8.35	8.50	8.65
1–2½–3½	6.55	7.30	7.45	7.60	7.75	7.90	8.05	8.20
1–3 –4½	6.20	6.95	7.10	7.25	7.40	7.55	7.70	7.85
1–4 –5	6.00	6.75	6.90	7.05	7.20	7.35	7.50	7.65
1–5 –6	5.65	6.40	6.55	6.70	6.85	7.00	7.15	7.30

SAN ANTONIO, TEX.—Prices per cu. yd. on city deliveries.‡

Mix		Mix	
1–3–5	6.50	1–2–4	7.00

‡Deduction of 50c per cu. yd. on large orders for delivery one mile of plant.

SAN JOSE, CALIF.—Prices per cu. yd. delivered within one mile of plant. (k)

Mix	Up to 5 cu. yd.	Over 5 cu. yd.	Mix	Up to 5 cu. yd.	Over 5 cu. yd.
1–6	9.00	8.50	1– 9	8.00	7.50
1–7	8.50	8.00	1–12	7.00	6.50

(k) For deliveries outside of this area add 30c per cu. yd. per mile. Cash discount of 50c per cu. yd. if paid in full by 10th day of following month.

SANTA CRUZ, CALIF.—Price per cu. yd. delivered within two-mile radius of plant. (l)

Mix	Over 5 cu. yd.	Less than 5 cu. yd.	Mix	Over 5 cu. yd.	Less than 5 cu. yd.
1–6 (6 sacks cement)	8.50	9.00	1–8 (4½ sacks cement)	7.60	8.10
1–7 (5 sacks cement)	8.00	8.50	1–9 (4 sacks cement)	7.40	7.90

(l) For deliveries outside of this area add 30c per cu. yd. per mile. Cash discount of 50c per cu. yd. if paid in full by 10th day of following month.

SPRINGFIELD, ILL.—Prices per cu. yd.

Mix		Mix	
1–3 –6	9.00	1–2 –3½	10.00
1–3 –5	9.20	1–2 –3	10.20
1–2½–4	9.45	1–1½–3	10.55
1–2 –4	9.75	1–1 –2	11.25

WATSONVILLE, CALIF.—Prices per cu. yd.‖

Mix		Mix	
1–6	9.90	1– 9	8.50
1–7	9.30	1–12	7.75
1–8	9.00		

‖Prices are for delivery anywhere within city limits, and are subject to cash disc. of 50c cu. yd. for payment on or before 10th day of following month.

WILKES-BARRE, PENN.—Prices per cu. yd. delivered within one mile of plant, subject to discount of 25c per cu. yd. for payment within 10 days from date of delivery. Extra charge of 15c per cu. yd. for each additional mile.

Mix	Gravel	Stone	Mix	Gravel	Stone
1–2 –3	7.60	7.90	1–3–5	6.75	7.05
1–2 –4	7.30	7.60	1–3–6	6.75	7.05
1–2½–5	7.00	7.30			

Recent Prices Bid and Contracts Awarded

Montpelier, Ind. County commissioners have awarded contracts for crushed stone at $1.46 per ton f.o.b. cars Montpelier, and at $1.49 per ton f.o.b. cars at Hartford City, Dunkirk, Millgrove, and other stations in this area.

Oxford, Ohio. Bids for gravel at the respective plants have been received by the city as follows: Millville Gravel Co., 45c. per cu. yd.; White Gravel Co., 65c.; Hamilton Gravel Co., 50c; Miami Gravel and Cement Co., 60c.; and A. B. Magaw, 90c.

La Porte, Ind. Bids of $1.45 per ton on stone were recently rejected by county commissioners as it was claimed they were too high. A bid of $1.62 a ton for slag was accepted. Gravel will be purchased for 90c. to $1.00 per cu. yd., it is believed.

Marion, Ohio. The city has contracted for sand and gravel at $1.50 per ton and for grade A stone at $1.00 and grade B 90c.

Hartford City, Ind. The county commissioners have contracted for crushed stone delivered at from $1.46 to $1.50 per ton, depending on point of delivery.

Ft. Wayne, Ind. Bids on 30,000 to 35,000 tons of crushed stone for Allen county highway maintenance have been accepted. The France Stone Co. bid 40c. per ton for stone to be shipped from Keyport and 45c. for stone from Middleport and Bellvue. The Erie Stone Co. bid 55c. for stone shipped from Huntington. Bids of both companies were accepted, based on the lowest delivered cost at various points.

Summitville, Ind. Hancock county commissioners have purchased gravel for 1932 at from 20c. to 50c. per cu. yd., the lowest price paid for several years.

Traverse City, Mich. The following bids on cement were recently opened by the city: P. Kyselka, $2.11 per bbl. in cloth and $1.86 in paper; Traverse City Lumber Co., $2.00 in cloth; Traverse City Milling Co., $2.09 in cloth and $1.84 in paper; Builders Material and Supply Co., $2.14 in cloth and $1.89 in paper. All prices subject to cash discount and credit for return of cloth sacks.

Valparaiso, Ind. The Consumers Co., Chicago, Ill., was low in bidding for Porter county crushed stone requirements in 1932. Its bid was $1.41 per ton and $1.21 for screenings. The France Slag Co. was awarded contract for furnishing slag at $1.46 per ton. Between 10,000 and 15,000 tons will be required.

Olympia, Wash. Bids for supplying the state with 6000 cu. yd. of minus ¾-in. road surfacing material were received as follows: Port Townsend Sand and Gravel Co., $1.18; C. E. Martin, $1.25; and R. O. Dail, $1.30.

Cleveland, Ohio. The city has purchased 4000 tons of granulated slag from the Goff-Kirby Co. at $1.41 per ton. Eight identical bids were submitted for 10,000 tons of binder stone.

Sand-Lime Brick Production and Shipments in February

THE FOLLOWING DATA are compiled from reports received direct from 18 producers of sand-lime brick, located in various parts of the United States and Canada. The statistics below may be regarded as representative of the industry in the United States and Canada.

Although the number of sand-lime brick plants reporting for the month of February is two less than for the preceding month, statistics for which were published in our issue of February 27, the figures indicate a decrease in production, shipments (both by rail and truck) and stocks on hand. Unfilled orders, however, remain about the same.

Average Prices for February

Shipping point	Plant price	Delivered
Detroit, Mich.	$13.00	$14.50
Jackson, Mich.	13.00	.....
Madison, Wis.	12.50*	14.00†
Menominee, Mich.	11.00	13.25
Milwaukee, Wis.	7.50	10.50
Minneapolis, Minn.	6.50	8.50
Mishawaka, Ind.	10.00	.....
Pontiac, Mich.	11.50	13.50
Saginaw, Mich.	11.00	.....
Syracuse, N. Y.	18.00	20.00
Tampa, Fla.	8.50	.....
Toronto, Ont., Can.	11.40	13.50

*Less 50c discount per M for payment 10th of month following invoice date. †Less $1.00 discount per M for payment 10th of month.

Statistics for January and February

	†January	*February
Production	2,188,150	1,538,450
Shipments (rail)	448,680	165,180
Shipments (truck)	2,560,693	1,580,106
Stocks on hand	9,066,624	8,255,238
Unfilled orders	8,700,000	8,306,000

†Twenty plants reporting. Incomplete, two not reporting production, and nine not reporting unfilled orders. *Eighteen plants reporting. Incomplete, nine not reporting unfilled orders.

Rock Products Operations of the U. S. Steel Corp.

THE ANNUAL REPORT of the United States Steel Corp. shows that its sales of portland cement (Universal Atlas Cement Co.) decreased 37.9% in 1931 as compared with 1930. Shipments of cement in 1931 were 14,343,432 bbl. against 23,084,305 bbl. in 1930, a loss of 8,740,873 bbl. Capital expenditures were made in the cement department of the company at the Buffington, Ind., mills, where progress was made in rebuilding the waste-heat boiler plant and dust-collection system.

In the limestone (Michigan Limestone and Chemical Co. and other subsidiaries) and flux department capital expenditures of $838,273 were made. The total amount of limestone, dolomite, fluorspar and cement rock produced in 1931 was 7,673,718 tons against 14,611,927 tons in 1930, a loss of 6,938,209 tons or 47.5%.

The number of common stockholders increased from 145,566 on December 31, 1930, to 179,572 on December 31, 1931.

Regarding the outlook for the steel industry in 1932 the report states: "It seems reasonable to suppose that on the basis of average demands in the United States for steel products during the past 10 years, the requirements of this country for maintenance and current uses alone, exclusive of development and expansion, should call for steel products in considerably greater tonnage than was consumed in 1931."

Oppose New York Sand and Gravel Dredging Bill

CHARACTERIZING the bill for the removal of sand and gravel from New York state lands under water, which Assemblyman Moffat of Manhattan has introduced at Albany, "a serious danger to Long Island," P. E. Twitchell, chairman of the Civic Federation of Northern and Middle Suffolk, urged in a statement that citizens of Long Island apprise their representatives in the legislature of their opposition to the measure.

Opposition to the bill also has been registered by the North Shore committee of the Long Island Chamber of Commerce. The amendments to the bill did not meet with the approval of the committee because in its opinion they would not sufficiently protect the interests of local communities.

Mr. Twitchell said the bill, if passed, would allow practically unrestrained dredging through the issuance of state permits. If the bill is to be passed, it must be amended to allow all permits to be passed on by the local governing bodies. The effect of the measure would be to destroy land values, increase erosion and cause upland digging to cease, it was also claimed.

The Moffat bill provides that offshore dredging of state lands under water may be permitted by the commissioners of the state land board, and that all materials so dredged shall be paid for on the following basis: 3c a cu. yd. for gravel, 2¼c a cu. yd. for sand, and 1½c a cu. yd. for grit and other materials.—*New York* (N. Y.) *Times.*

A. S. T. M. Appoints New Subcommittee on Hydraulic Limes

THE ADVISORY committee of C-7 on lime, of the American Society for Testing Materials, has a new subcommittee as a nucleus "for the instigation of work and study pertaining to hydraulic limes." The personnel of the subcommittee comprises: Wm. E. Carson, president, Riverton Lime Co., Riverton, Va., chairman; J. S. Elwell, Western Lime and Cement Co., Milwaukee, Wis.; L. S. Trainor, National Lime Association, Washington, D. C.; Dr. L. S. Wells, United States Bureau of Standards, Washington, D. C.; F. A. Jones, consulting engineer, Canton, Ohio; Nathan C. Rockwood, editor, Rock Products, Chicago, Ill.

Cement Mills Meet for Safety

Regional Conferences Held at Birmingham, Ala., and at Indianapolis, Ind.

IRRESPECTIVE of what may be happening in the commercial aspects of the cement industry, the operating departments are following the slogan "Safety as Usual." This fact was very evident when delegations of the southeastern member mills of the Portland Cement Association met at Birmingham, Ala., February 19, and the Indiana, Kentucky and Southwestern Ohio mills met at Indianapolis, Ind., February 26.

Regional safety meeting at Indianapolis

Birmingham Meeting

At Birmingham, Stanley Owens, safety engineer of the association, gave a report and analysis of accident prevention work over the entire industry during the past year. Speakers on "How to Win the Association Trophy" were O. C. Brown, chief clerk of the Lehigh mill at Birmingham; E. P. Lipscomb of the Lone Star plant at Spocari, Ala.; H. A. Blake of the Lone Star plant at Birmingham, and D. M. Goss of the Leeds plant of Universal Atlas, each representing a mill which completed 1931 without a lost-time accident.

Other papers presented at the meeting were: "Cement Plant and Quarry Safety Rules," by J. J. Woodman, storekeeper of the Lone Star plant at Birmingham; "Recent Developments in the Prevention and Control of Infection," by H. E. Conwell, orthopedic surgeon for the Tennessee Coal, Iron and Railroad Co.; "Eye Protection," by Jack Rennie, Birmingham, representative of the American Optical Co.; "Eliminating Minor Accidents," by M. T. O'Connor, Pennsylvania-Dixie Cement Corp., Kingsport, Tenn., and "Proper Handling of Safety Suggestions," by B. E. Merrell.

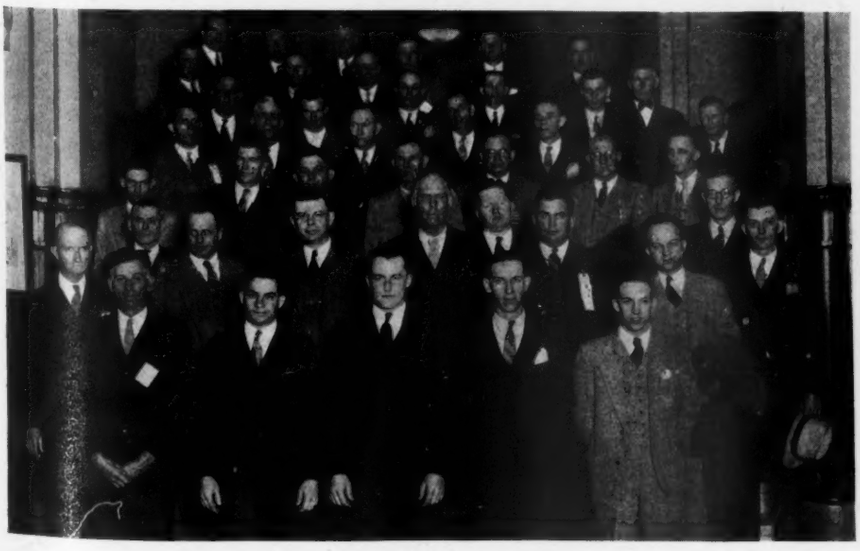
To conclude the meeting, Perkins J. Prewitt, director of the Birmingham Safety Council, outlined plans of the Safe Drivers League, which was suggested by the cement section of the National Safety Council. The meeting warmly supported this project.

O. C. Brown in his talk explained the organization of the safety committee of his plant which consists of 14 members, the superintendent of the plant acting as chairman. This committee is divided in the following groups: inspection committee, fire committee, first-aid and sanitary committee, and publicity committee. In conclusion, Mr. Brown said, "We are frank to admit that while protecting machinery for accident hazards had a bearing on our success, the real solution to the problem is education of the employes."

E. P. Lipscomb praised the attitude of the management for the record of his plant. The installation of safety devices, including the elimination of dust, and a bonus system, he said, had been a great incentive and were other important factors. The intensive educational program was credited by D. M. Goss with the success of the Leeds plant of Universal Atlas in its safety drive in 1931. The methods followed in this educational program were outlined in considerable detail.

In discussing cement plant and safety rules J. J. Woodman explained that his company policy was to give all employes a thorough medical examination and base their service on the information thus developed. Good housekeeping both in the plant and quarry is a rule that is strictly enforced. He outlined the safety measures followed in the quarry and emphasized the important position the foreman plays in every safety program.

The importance of full consideration of every suggestion offered by employes to maintain their good-will and at the same time realize the benefits of such suggestions were pointed out by B. E. Merrell. The superintendent's responsibility as well as that of the foreman were emphasized. Methods of maintaining records of suggestions that the maximum value would result were outlined.



Group at Birmingham regional safety meeting

Indianapolis Meeting

Following the report of Mr. Owens, safety engineer of the association for 1931; O. R. Cornelius, safety director, Southwestern Portland Cement Co., Osborn, Ohio, outlined the following as factors which made it possible for his company to achieve a perfect safety record during 1931: Rotation of the plant employes on the plant safety committee; installation of guards and safe working practices; monthly safety bonus; continual educational work; and efficient first aid service. Since 1927 he said the cost of accidents at this plant had declined 98.3%. Infections have been practically eliminated.

Hugh Walker, secretary of the safety committee of the Greencastle plant of the Lone Star Cement Co., Indiana, also attributed the cultivation of the individual workman as a paramount factor in safe operations.

John O'Callaghan, superintendent of the same plant, in discussing safety rules, explained the difficulties involved in properly selling safety rules to plant personnel and the practical methods of enforcement. He favored the Kangaroo court method in small plants. The method which his plant has found most satisfactory is a lay-off plan. In this plan the foreman assumes responsibility to the superintendent for accidents in his department. Following accidents the foreman has authority to lay-off the workman who has violated a safety rule. He reported that expulsion had shown this worker returned at the termination of his lay-off period a better and safer worker.

Rules of special importance at the Greencastle plant were given as: Starters must be locked before repairs or adjustments are attempted; horseplay in any form is forbidden; plant neatness is required; wearing of goggles by packers and others exposed to eye hazards is required; and immediate reporting for first-aid is insisted upon.

Other speakers at the conference were Lieut. Frank R. Owen, representing the Indianapolis City Safety League, who explained the Safety Drivers League; D. E. Willingham, plant engineer, Louisville Cement Co., who spoke on "Avoiding Electrical Accidents," and W. H. Weitknecht, superintendent, Lehigh Portland Cement Co.'s plant at Mitchell. Mr. Willingham stated three don'ts which would practically eliminate electrical accidents if strictly followed. These rules were: Don't make an electrical conductor of yourself; don't become reckless with electric current and cause flashes; and don't allow unauthorized people to tamper with electrical equipment.

Other suggestions which he made were: The electrical department should see that all metal non-current carrying parts of electrical equipment, especially switch cases and motor frames, should be grounded; rubber mats or insulated platforms should be used in front of all starting equipment; rubber gloves should be owned and used by electricians when it is necessary to work on hot lines; rubber or insulation blankets for covering exposed electrical conductors should be available; extension cords should not be used for lighting in boilers or steel drums; some approve a low voltage line lamp, others require the use of flashlights in such work, he said.

"Stunts" Promote Safety

Pennsylvania-Dixie Organization Organizes for Success and Attains Goal

By R. A. Bechtold
Superintendent

OUR MILL at Valley Junction, Ia., a suburb of Des Moines, believes in safety down to the last man and has put its belief into action.

First of all, there could be no argument with us as to the value of avoiding personal injuries to ourselves and our associates nor did any of us harbor doubt that accidents could be eliminated. But we knew that it would mean constant vigilance and hard work. So we started in at the beginning by preparing a plan and getting organized.

Our plan has worked so well and our foremen and workmen have supported it so whole-heartedly that we have suffered no lost time accident since December 16, 1930, about 375 days at this writing. This record is very much better than has ever been attained before and we believe that it can be continued almost indefinitely. Since it may be of interest and benefit to others, I am going to describe our more important safety activities briefly.

The general safety committee meets semi-monthly. Membership in the committee comprises all of our foremen. This committee appoints the workmen's safety committee, which consists of four men selected from the various departments. At each meeting of the general safety committee two workmen are appointed to serve on the workmen's committee for one month. Thus, while the general committee retains the same membership, the make-up of the workmen's committee changes constantly. In the course of a year a total of 48 men are thus given an opportunity to serve for a month's period. This is a decidedly helpful factor.

The general safety committee discusses all business relative to the safety work, passing on all resolutions and recommendations and serving as a nucleus for all safety activities. It is the duty of the workmen's committee to assemble on the first day of each week and make a complete inspection of all departments and prepare in writing all suggestions for improvement or correction of conditions. These suggestions are presented to the general committee for discussion and disposition at each regular meeting. This system of handling affords the opportunity to a large proportion of the workmen to take a definite part in the work.

Mass meetings have been held during the year, and in addition to talks given by our own men outside speakers are frequently secured with the idea of presenting new thoughts stimulating enthusiasm and broadening the safety background of the entire group of employes.

Two new "stunts" were developed for the last June No Accident Campaign. On the first day of June each foreman was required to start raising a mustache which he was to wear during the entire month. However, should an accident occur in any department, all mustaches could be shaved off on the first of July excepting the foreman of the department in which the accident occurred. At the discretion of the committee, he would be required to wear his mustache the balance of the year.

The second stunt required a man to go through the entire mill daily wearing a convict suit made from white overalls with thirty black stripes sewed on. Each stripe represented one day of the month. For each safe day passed, one stripe was allowed to be removed. A suit without stripes at the end of the month represented a perfect safety record for the duration of the campaign. These two stunts proved very effective in reinforcing our regular program.

Following the June No Accident Campaign, every employe was instructed to write a safety letter covering any phase of the subject he might wish to discuss. There were to be no restrictions. He was to present it in his own form and language. Each day a letter was posted on the bulletin board for all employes to read. Much interest was manifested by this scheme, as every letter turned in proved original as well as valuable. Some outstanding safety points and ideas were presented.

More Silicosis Suits Started

SIX NEW SUITS have been started against the Ottawa Silica Co., Ottawa, Ill., bringing the total number of damage cases filed in the circuit court against the company by former employes to 27. The plaintiffs in the 27 suits are asking a total of $957,500 damages.

In addition to these cases a $65,000 damage suit against the Standard Silica Co. has been filed in the circuit court by a former employe of that company who claims to have contracted silicosis.

The plaintiffs in almost all of the cases filed their suits as poor persons to escape paying court costs.—*Princeton* (Ill.) *Record.*

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